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OFFICIAL REGISTER

OF

PRINCETON UNIVERSITY

VOLUME I FEBRUARY 15, 1910 NUMBER 6

Department of Biology

ANNOUNCEMENT FOR
1910-1911

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OFFICIAL REGISTER

OF

PRINCETON UNIVERSITY

VOLUME I FEBRUARY 15, 1910 NUMBER 6

Department of Biology

ANNOUNCEMENT FOR
1910-1911

Published by Princeton University
PRINCETON, N. J.

OFFICIAL REGISTER OF PRINCETON UNIVERSITY

[Entered as second-class matter, December 23, 1909, at the Post Office at Princeton, N. J. under the Act of July 16, 1894]

Issued twice a month during December, January and February and monthly in March and June

These publications include

The Catalogue of the University.

The Reports of the President and the Treasurer.

The Bulletin of the University.

The Announcements of the several Departments, relating to th work of the next year. These are made as accurate as possible but the right is reserved to make such changes in detail a circumstances may require.

The current number of any of these publications will be sen upon application to the Secretary of the University, Princeton New Jersey.

PRINCETON UNIVERSITY

Department of Biology

UNDERGRADUATE AND GRADUATE COURSES, MUSEUM, LABORATORIES, FELLOWSHIPS, HIGHER DEGREES

ANNOUNCEMENT FOR
1910-1911

Published by Princeton University
1910

Printed by
Princeton University Press
Princeton, N. J,

FACULTY

Woodrow Wilson, Ph.D., Litt.D., LL.D., *President.*

Henry Burchard Fine, Ph.D., LL.D., *Dean of the Faculty, Dean of the Departments of Science.*

Andrew Fleming West, Ph.D., LL.D., Hon. D.Litt. (Oxon.), *Dean of the Graduate School.*

William Berryman Scott, Ph.D., LL.D., *Blair Professor of Geology.*

Walter Mead Rankin, Ph.D., *Professor of Biology.*

Charles Freeman Williams McClure, Sc.D., *Class of* 1877 *Professor of Zoology.*

Edwin Grant Conklin, Ph.D., Sc.D., *Professor of Biology, Chairman of the Biological Department.*

Ulric Dahlgren, A.B., M.S., *Assistant Professor of Biology, Secretary of the Biological Department.*

Marcus Stults Farr, Sc.D., *Preceptor in Geology.*

Charles Frederick Silvester, *Assistant in Anatomy, Curator of the Museum of Zoology.*

Guy Chester Crampton, Ph.D., *Assistant in Biology.*

Lewis Robinson Cary, Ph.D., *Teaching Fellow in Biology.*

UNDERGRADUATE COURSES

The undergraduate work in Biology is arranged to meet several distinct needs. The most immediate of these is to give every student a concise and well ordered knowledge of organic life and its processes such as every liberally educated man should have. This work is represented in its minimum form by the course in "General Biology" given in the Junior year. This course, while serving the cause of general culture, also stands as the first of a series of other and more specialized courses designed to prepare men for the study of medicine, hygiene and sanitation and other biological professions. Attention is called to the fact that Biology is now required for admission to most medical schools. Candidates for the degrees of A.B. or B.S. may

elect the Department of Biology in their Junior and Senior years, and the courses in Biology may be taken as electives by any properly qualified student.

The entire series of undergraduate courses, described below, also prepares the student for the graduate work in Biology which trains him for the profession of teaching and investigation and may lead to the degrees of A.M. and Ph.D.

41, 42. General Biology. Lectures, laboratory work, and recitations. An introduction to the fundamental properties of living things, their functions, structures, classification, habits, life-histories, and evolution. Selected forms are studied in the laboratory as illustrating the chief principles and generalizations of biology. Reference books; Packer and Parker, *Practical Zoology;* Hertwig and Kingsley, *Zoology;* Sedgwick and Wilson, *General Biology.* Junior course, both terms, 3 hours a week. Prerequisite to the subsequent courses in Biology. Professor Conklin, Dr. Crampton and Dr. Cary.

43, 44. Botany. Practical work in the field and laboratory, lectures and recitations. An introduction to the general principles of plant life. Besides the structure and functions of plants, their taxonomy and their relation to their environment will be studied, use being made of the facilities offered by the grounds of the Biological Laboratory. Atkinson: *College Botany;* Curtis: *Nature and Development of Plants;* Bergen and Davis: *Principles of Botany.* Junior course, both terms, 3 hours a week. Professor Rankin.

*71. Comparative Anatomy of Vertebrates. Lecture and laboratory course. Lectures on the comparative anatomy of the organ systems of vertebrates, and dissection of the following forms: Amphioxus, the dogfish, the pigeon, and a mammal. Marshall and Hurst:

Practical Zoology. Reference books: Kingsley: *Vertebrate Zoology;* Wiedersheim: *Vergleichende Anatomie der Wirbelthiere.* Senior course, first term, 3 hours a week. Prerequisite course: Junior course in General Biology. Professor McClure and Mr. Silvester.

*72. Vertebrate Embryology. Lecture and laboratory course. A comparative study of the development of vertebrates. Hertwig: *Text-book of Embryology,* Marshall. Senior course, second term, 3 hours a week. Professor McClure and Mr. Silvester.

*73. Histology. A study of protoplasm, the cell, and the tissue as they underlie animal and vegetable life. Required text-book: Dahlgren and Kepner: *Principles of Animal Histology.* Reference books: F. T. Lewis: Stohr's *Text-book of Histology;* Schnider: *Histologie der Tiere;* Wilson: *The Cell in Development and Inheritance.* Senior course, first term, 3 hours a week. Professor Dahlgren.

*74. Advanced Histology and Neurology. The comparative Histology of the nervous tissues and neuroglia; an outline of the structure of several important types of nervous systems including the vertebrate type; and work on several other special groups of tissues. Practice in microscopical technic. Thesis. Required text-books; Dahlgren and Kepner: *The Principles of Animal Histology;* J. B. Johnson: *The Nervous System of Vertebrates.* For reference, see books and original articles listed in the outlines of the work. Senior course, second term, 3 hours a week. Professor Dahlgren.

75. Comparative Osteology. Ontogeny and comparative structure of the skeleton of the different classes of vertebrates. Exercises in descriptive work. Each student must prepare a thesis on a skeleton specially

assigned for his study. Flower: *Osteology of the Mammalia;* Reynolds: *The Vertebrate Skeleton.* The monographs on the skull, the shoulder-girdle, human anatomy. Senior course, first term, 3 hours a week. Prerequisite course: Junior course in Biology. Professor Farr.

76. Vertebrate Palaeontology. Lectures and laboratory work on fossil vertebrates. Smith-Woodward: *Vertebrate Paleontology;* Zittel: *Handbuch der Paleontologie.* Senior course, second term, 3 hours a week. Prerequisite courses: Biology 41, 42, and Osteology. Professor Farr.

GRADUATE COURSES

While such of the undergraduate courses as are marked with an asterisk in the preceding pages may be taken by graduates, the courses outlined below are intended only for graduates. Any of the following courses will be given if applied for by any duly qualified graduate student.

The courses which are open to graduate students only are as follows:

101. Cytology. Lectures, laboratory and research work on protoplasm; the structures and functions of cells; nuclear and cell division; origin and maturation of the germ cells. First term, 3 hours a week. Professor Conklin.

102. Ontogenesis. Lectures, laboratory and research work on the fertilization, cleavage and promorphology of the egg; phenomena of differentiation; problems of experimental embryology; the cellular basis of heredity and evolution. Second term, 3 hours a week. Professor Conklin.

103. Comparative Histology and Histogenesis. Studies of supporting, nutritive, excretory, respiratory and several other groups of tissues, including their origin

and development; repair, regeneration and metamorphosis. Lectures, laboratory and research work. First term, 3 hours a week. Professor Dahlgren.

104. Histology of the Kinetic and Nerve Tissues. Comparative studies of the organs and tissues which produce light, heat, motion and electricity; the tissues of nervous sensation, communication and stimulation; the organization of nerve tissues in several animal forms. Lectures, laboratory and research work. Second term, 3 hours a week. Professor Dahlgren.

105. Morphology of the Organ Systems of Vertebrates. This course is designed to give a comprehensive idea of the principles of vertebrate anatomy as based upon a comparative study of the anatomy and development of the organ system of vertebrates. The course will consist chiefly of lectures, illustrated by a large number of anatomical preparations, of which about 3,000 are at present available for study. First term, 3 hours a week. Professor McClure.

106. Special Problems of Vertebrate Anatomy. This course is designed for those who wish to begin independent investigations in Comparative Anatomy of Vertebrates. Second term, 3 hours a week. Professor McClure.

107. The Development of Plant Life. Studies in the structure, life-history and taxonomy of various groups of plants. First term, 3 hours a week. Professor Rankin.

108. Systematic Botany of the Vascular Plants. Structure as related to description and classification. Exercises in plant analysis, description and classification. The characters of the larger families of Angiosperms. Second term, 3 hours a week. Professor Rankin.

110. Theories of Evolution. A history of the doctrine of evolution, with discussion of the theories which have been proposed to explain the modes and factors of

development. Second term, 3 hours a week. Professor Scott.

111, 112. (Geology 109, 110.) Vertebrate Palaeontology. Lectures and laboratory work on the morphology and evolution of fossil vertebrates. Both terms, number of hours indefinite. Professors Scott and Farr.

BIOLOGICAL SEMINARY AND JOURNAL CLUB

This is an organization of the instructors and graduate students of the department, which meets weekly throughout the academic year for the presentation of the results of original work, reports upon assigned topics, and reviews of recent biological literature.

THE NATURAL SCIENCE ASSOCIATION

An organization composed of the instructors and graduate students of the departments of Biology and Geology, and of other residents of Princeton especially interested in the natural sciences. Meetings are held once or twice a month, at which time papers of general interest are presented and discussed. Lectures are also given by members of the association and by naturalists from a distance, which are open to the public.

BUILDINGS, FACILITIES, ETC.

The Biological Department is housed in the east half of Guyot Hall, which was erected in 1909 at a cost of about $425,000. This building is situated at the southeast corner of the campus on the southerly slope below the Palmer Physical Laboratory, and beyond it fields, woods and brooks extend down to Lake Carnegie, thus affording unrivaled opportunities for biological gardens and vivaria.

The inside dimensions of the building are 288 feet long and 56 feet wide, with a south extension 63 feet long by 35 feet wide. Its central section has a basement and four

stories, and the ends and extension have three and two stories respectively. With a cubical content of about 1,250,000 cubic feet it has a total serviceable floor space of about 85,146 square feet.

Architecturally it is a very successful application of the English Gothic style to the strict requirements of modern laboratory construction.

The chief material used is brick of variable light red tone with Indiana limestone trimmings, and the construction is fireproof, being of steel, reinforced concrete, and plaster block.

The approved features of modern laboratories of this class have been adopted: simplicity of design, stability, fireproofing, maximum of window lighting, use of sound-proof though easily removable partitions, with generous provisions of electric illumination and power, gas and water supply. Two freight elevators, one electric the other hand power, run from cellar to top floor. The general artificial illumination is provided by the alternating current system, and a 30 K. W. motor-generator set furnishes direct current for the projection and photo-illumination apparatus. Abundant gas supply is at hand for secondary illumination and heating on laboratory tables. Natural ventilation is relied on to a large extent, almost entirely so in the west end of the building. A ventilating plant provides tempered forced draft and exhaust for the corridors, museum, lecture room, reading room, and certain laboratories where noxious fumes and odors may be generated. Independent minor exhaust systems care for the proper circulation in the photographic rooms. Adjoining the building is a vivarium and greenhouse.

The Departments of Biology and Geology occupy approximately equal portions of the building, Biology having the eastern and Geology the western end, and certain rooms are used in common; i. e., the museum, the large lecture room,

the general library and reading room. The museum occupies the entire first story, having a height of 18 feet, and, with its gallery along the south side of the central section, affords about 19,300 square feet of floor space. Here will be exhibited selected material from the Biological Museum, the Morphological Museum, the E. M. Museum of Geology and Archaeology, and the Mineralogical Museum. The lecture room, central in the basement, with 210 seats, has brilliant natural and complete indirect artificial illumination, and is provided with all appurtenances needed for conducting lecture courses and meetings of scientific societies. The library, centrally located on the second floor, has a reading room space of 25 x 25 feet and lateral stacks holding the working libraries of the biological and geological sciences, with capacity for about ten thousand volumes.

The laboratories are arranged in ten separate suites, each suite as a rule accommodating a distinct subject, and five such suites are in each department. In addition there are rooms for graduate students and for investigators, seminary rooms, a club room for students of the Department of Geology, machine shops, curatorial, preparation, and store rooms, and finely equipped quarters for photographical work. Special rooms are designed for seismographical and meteorological stations. Excluding several rooms used for janitorial and other purposes, 103 rooms are devoted to the work of the scientific departments.

THE NATURAL SCIENCE MUSEUM

The Natural Science Museum, occupying the first floor of Guyot Hall, with a floor area of about 19,300 square feet, contains the collections formerly included in the E. M. Museum of Geology and Archaeology, the store rooms of the Department of Geology, the Museum of Biology, the Class of 1877 Morphological Museum, and the Mineralogical Museum of the John C. Green School of Science.

The Zoological Collections are especially rich in osteological and ornithological material. The former includes a large number of mounted and disarticulated skeletons of fishes, reptiles, birds and mammals. The collections of mounted and unmounted bird skins are especially large, including some sixteen thousand individuals, representing very completely the avifauna of New Jersey, and in part that of North America, Europe, Indo-Asia, Australia, and South America. These collections are supplemented by some four thousand sets of eggs, most of them in nests.

The Morphological Museum contains about three thousand preparations, illustrating the comparative anatomy of vertebrates. This collection, which consists of dissections and corrosions, is being increased constantly at the rate of about three hundred preparations a year, all of which are prepared in the laboratory by the Curator and his assistants.

The Histological Collection is located on the second floor of the building and consists of some thirty thousand mounted microscopical specimens illustrating the various forms of tissues of many different animals; some five thousand specimens are stored in paraffin blocks.

The Botanical Collections are arranged on the third floor and include, besides certain illustrative specimens, models and charts, a Herbarium of mounted plants, classified according to Engler and Prantl's *Pflanzenfamilien*. The Herbarium includes a local collection, representing the New Jersey flora, of four thousand sheets; some forty thousand sheets of plants from different sections of the United States, from South America, Europe and Asia, and ten thousand sheets of mosses, recently acquired from Dr. Per Dusen of Sweden.

The Palaeontological Collections are particularly rich and valuable and include large series of Tertiary fossils from the western part of the United States, and from Patagonia.

THE BIOLOGICAL LABORATORIES

The Biological Laboratories are located in the east half of Guyot Hall and comprise, in addition to the museums, the library, laboratories, research rooms and seminary rooms of the Departments of *Z*oology, Physiology and Botany.

The *Z*oological and Anatomical Laboratories include five class rooms, equipped as laboratory-lecture rooms, seven private research rooms, two preparation rooms, a chemical room, two photographic rooms, an artist's room and six store rooms.

The Physiological Laboratory comprises one large laboratory-lecture room, two smaller laboratories, three private research rooms, a photographic room and a store room; it closely adjoins the animal rooms in the sub-basement and vivarium.

The Botanical Laboratory includes, at present, one laboratory-lecture room, four private rooms and the herbarium room. A greenhouse and vivarium afford, at all seasons, a considerable variety of land, fresh-water and marine plants for study. It is hoped that in the near future the extensive grounds south of Guyot Hall may be laid out as a botanical garden and arboretum.

The Palaeontological laboratories are part of the Geological equipment and are found in the west half of the building.

Vivaria. The study of living plants and animals is a most important part of Biology, and unusual facilities are here offered for such study. In addition to the natural advantages of the situation, afforded by the presence, in the immediate vicinity of the Laboratory, of fields, woods, brooks, Lake Carnegie and the canal, especial preparations have been made for keeping under experimental and observational conditions a considerable variety of animals and plants. The Vivarium is a separate building with glass roof

and large concrete aquaria; the latter have an aggregate area of nearly four hundred square feet, one half of which is devoted to sea-water and the other half to fresh-water. In addition there are rooms with suitable cages for keeping insects, amphibians, reptiles, birds and mammals; also private research rooms, photographic rooms and pump rooms. Adjoining the building are flying cages for birds, runways for mammals, and a large greenhouse for plants. Near the Vivarium a biological lake has been formed by damming up a brook, and various cages and retreats will be established along the brook and in the woods where many animals may be kept and studied under natural conditions.

LIBRARY

The Biological Library consists of about five thousand volumes. It contains sets of about eighty of the principal biological periodicals, as well as standard reference books and monographs; through the generosity of Mr. Charles W. McAlpin, of the class of 1888, several hundred volumes are added to it each year.

PUBLICATIONS

Reprints of scientific articles published by members of the Biological Department are collected and issued in volumes under the general title, *"Contributions from the Biological Laboratories of Princeton University."*

FELLOWSHIPS AND SCHOLARSHIPS

The following fellowships and scholarships are open to graduate students in the department of Biology:

Class of 1877 University Fellowship in Biology. This fellowship pays to the holder $400 per annum.

Francis Hinton Maule Biological Fellowship

This fellowship was founded in 1901 by Mr. and Mrs. Francis I. Maule as a memorial of their son, Francis Hinton Maule, who was a student in the University during the years 1895-98. It is conferred by appointment of the faculty and pays the holder the income of $10,000.

The E. M. Biological Fellowship

This fellowship conveys the use of a table in the Laboratory of the U. S. Bureau of Fisheries at Woods Hole, Mass., together with all the facilities afforded for the collection and study of animal life during the season favorable for such investigations. A small stipend which varies from year to year is paid the holder. This will amount to not less than $150 during the year 1910-11. This fellowship is conferred by appointment of the Faculty.

In addition to the above named fellowships there are a number of unassigned University fellowships and scholarships, some of which may be allotted each year to the Department of Biology. In general these fellowships pay the holder $400 per annum, while the scholarships pay from $100 to $200. All applications for fellowships and scholarships should be in the hands of the Dean of the Graduate School not later than March 15th.

Applications received later than March 15th may be considered in special cases, and to fill vacancies.

GENERAL REGULATIONS

The terms of admission to the undergraduate courses, system of undergraduate study, and tuition and other fees for the undergraduate years may be learned from the University Catalogue. Regulations governing the admission of graduate students, fees for graduate courses, and the granting of higher degrees are contained in the general circular

on the Graduate School. The following is a brief summary of these regulations:

All graduate students, whether graduates of Princeton or of another institution, are required to enroll their names at the office of the Dean of the Graduate School before October first of each year, and those who present themselves for the first time must submit to the Dean their diplomas and such other credentials as may be required.

Graduates of other universities than Princeton are required to pay a matriculation fee of five dollars. All graduate students, except Fellows, shall pay the sum of five dollars for each course each term. The total maximum charge is not to exceed twenty dollars a term.

DEGREES

The degrees given for graduate study are Master of Arts and Doctor of Philosophy. The degree of Master of Arts may be conferred upon those who hold a Bachelor's degree in the liberal arts and sciences and who shall also have devoted at least one year exclusively to resident graduate study in the University, or shall have taken graduate courses in the University involving at least three hours a week each term for four terms. The fee for the degree is ten dollars.

The degree of Doctor of Philosophy may be conferred upon any Bachelor of an approved institution, who has spent at least two years exclusively in study for the degree. It should be clearly understood that two years is the minimum period required, and that in all but the rarest cases three years will be found necessary. One year must be spent in residence at Princeton.

A candidate for this degree must be endorsed by the Department in which his subject of study lies and must present satisfactory certificate of his ability to use French and German as instruments of research.

Before offering himself for the final examination the candidate is expected to have acquired a broad general knowledge of the subject which he has chosen and a comprehensive and detailed knowledge of some one main division of it. In certain cases, however, the candidate may, on the recommendation of the Department in which his subject lies and with the approval of the Committee on the Graduate School, substitute for a main division of his subject a like division of a germane subject; or he may be required to take additional work outside his subject.

The candidate shall present to the Department in which his work chiefly lies a thesis on some topic in the special field of his study. If the thesis is accepted by the Department, as giving evidence of high attainment and the power of independent research, the candidate will be recommended by the Department to the Committee on the Graduate School for admission to the final examination. This recommendation must be accompanied by a statement of the amount and character of the graduate work done and by the formal approval of the thesis.

Examinations for the Doctor's degree are conducted orally in the presence of the Faculty and cannot be divided. A written examination may precede the oral examination if the examiners so desire. A candidate who passes the examination must print his thesis and deposit 100 copies of it in the University Library. A satisfactory guaranty of the delivery of these copies must be furnished before the conferring of the degree.

Those who apply for the degree shall pay to the Dean of the Graduate School a fee of sixty dollars, in two instalments of thirty dollars, the first to be paid when the candidate is enrolled and the second when he sends in his thesis.

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OFFICIAL REGISTER

OF

PRINCETON UNIVERSITY

VOLUME IV APRIL 1, 1913 NUMBER 9

Department of Biology

ANNOUNCEMENT FOR
1913-1914

UNIVERSITY OF ILLINOIS
PRESIDENT'S OFFICE

MAY 17 1913

Published by Princeton University
PRINCETON, NEW JERSEY

OFFICIAL REGISTER OF PRINCETON UNIVERSITY

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PRINCETON UNIVERSITY

Department of Biology

UNDERGRADUATE AND GRADUATE COURSES,
MUSEUM, LABORATORIES, HIGHER DEGREES,
FELLOWSHIPS, THE GRADUATE COLLEGE

ANNOUNCEMENT FOR
1913-1914

Published by Princeton University
1913

CALENDAR

1913

Sept. 24.	First term begins.
Sept. 25, 3 P. M.	Formal opening exercises.
Sept. 30.	Last day for enrolment of Graduate students at the office of the Dean of the Graduate School and the office of the Registrar.
Nov. 26, 1.30 P. M.—Dec. 1, 10.30 A.M.	Thanksgiving recess.
Nov. 27.	Thanksgiving Day
Dec. 20, 1.30 P. M.	Christmas vacation begins.

1914

Jan. 5, 10.30 A.M.	Christmas vacation ends.
Feb 12.	Second term begins.
March 15.	Last day for receiving applications for Fellowships and Graduate Scholarships.
April 8, 1.30 P.M.—April 14, 10.30 A M.	Spring recess.
June 14.	Baccalaureate Sunday.
June 15.	Commencement meeting of the Board of Trustees—Annual meetings of the Literary Societies—Class Day.
June 16.	167th Annual Commencement—Alumni Trustee election—Alumni luncheon.

FACULTY

JOHN GRIER HIBBEN, PH.D., LL.D., LITT.D., *President.*

ANDREW FLEMING WEST, PH.D., LL.D., HON. D.LITT. (OXON.), *Dean of the Graduate School.*

HENRY BURCHARD FINE, PH.D., LL.D., *Dean of the Departments of Science.*

WILLIAM FRANCIS MAGIE, PH.D., *Dean of the Faculty.*

HOWARD MCCLENAHAN, E.E., M.S., LL.D., *Dean of the College.*

WILLIAM BERRYMAN SCOTT, PH.D., LL.D., *Blair Professor of Geology.*

WALTER MEAD RANKIN, PH.D., *Professor of Biology, Secretary of the Department of Biology.*

CHARLES FREEMAN WILLIAMS MCCLURE, SC.D., *Class of* 1877 *Professor of Zoölogy.*

EDWIN GRANT CONKLIN, PH.D., SC.D., *Professor of Biology, Chairman of the Department of Biology.*

ULRIC DAHLGREN, A.B., M.S., *Professor of Biology.*

MARCUS STULTS FARR, SC.D., *Assistant Professor, Preceptor in Geology.*

CHARLES FREDERICK SILVESTER, *Assistant in Anatomy, Curator of the Museum of Zoölogy.*

LEWIS ROBINSON CARY, PH.D., *Instructor in Biology.*

EDMUND NEWTON HARVEY, PH.D., *Instructor in Physiology.*

STEWART PATON, M.D., *Lecturer in Biology.*

HARLEY NATHAN GOULD, A.B., Allegheny College, 1910, *Assistant in Biology.*

EDWARD HOWLAND WARDWELL, B.S., Princeton University, 1911, *Assistant in Biology.*

FELLOWS, 1912-13

EDWIN EUSTACE REINKE, A.B., Lehigh University, 1908. *Gordon MacDonald Fellow in Biology.*

LOUIS MAX HICKERNELL, A.B., Allegheny College, 1910. *Francis Hinton Maule Fellow in Biology.*

WILLIAM EDWIN HOY, JR., A.B., Franklin and Marshall College, 1911. *Class of* 1877 *University Fellow in Biology.*

SCOPE OF THE COURSES IN BIOLOGY.

The work of the Department of Biology falls into five subdivisions depending upon the subject matter; these are (1) General Biology, (2) Botany, (3) Physiology, (4) Zoölogy and Animal Morphology, (5) Osteology and Palaeontology.

1. The first of these subdivisions includes courses in General Biology (201, 202), and Theories of Evolution (510).

2. The courses in Botany include at present the following:—General Botany (303, 304), The Development of Plant Life (507), Systematic Botany of the Vascular Plants (508).

3. The following courses are offered in Physiology:—General Physiology (407, 408), Physical Chemistry of the Cell (513, 514), Preparation of Biological Compounds (519, 520).

4. The courses in Zoölogy and Animal Morphology are:—Invertebrate Zoölogy (306), Comparative Anatomy of Vertebrates (401), Vertebrate Embryology (402), Histology (403), Advanced Histology (404), Cytology (501), Ontogenesis (502), Comparative Histology and Histogenesis (503), Histology of Kinetic and Nerve Tissues (504), Morphology of Organ Systems of Vertebrates (505), Special Problems of Vertebrate Anatomy (506), Morphology and Physiology of the Central Nervous Systems (515, 516), Normal and Experimental Embryology (517, 518).

5. The Courses in Palaeontology and Osteology are:—Comparative Osteology (305), Vertebrate Palaeontology (406), Vertebrate Palaeontology (511, 512).

ADMISSION TO COURSES

All undergraduate work in the Department of Biology is elective, though some courses may be taken only in a pre-

scribed sequence. An elementary course in general chemistry is prerequisite to the course in General Biology (201, 202.) This course is open to Sophomores, Juniors and Seniors in all courses; it is prerequisite to all other subjects in the Department except Botany 303,304, which is open to Juniors in all courses. All other undergraduate work in Biology is open to Seniors in all courses, who have had the prescribed prerequisites.

Candidates for the degrees of A.B. and B.S. who elect the Department of Biology for the major work of their Junior and Senior years are required to take not less than two of these courses throughout the Junior year and not less than three throughout the Senior year. Since there are more than three Senior courses offered, some selection must be exercised and it is desirable for a Sophomore about to elect the Department to consult with some of its members as to a proper selection.

Any undergraduate course may be taken by graduate students, but only the advanced courses which are marked with an asterisk in the following list may count as graduate work. The graduate courses are open only to properly qualified graduate students.

CHOICE OF COURSES WITH REFERENCE TO PARTICULAR AIMS

It is recognized that the purposes and needs of different students are various and the selection of courses in Biology should be made with reference to individual requirements. However there are certain general purposes for which certain courses are particularly recommended.

1. *General Culture.* All courses offered by the Department of Biology are cultural courses, dealing with the science in a philosophical rather than a technical manner, but among the courses some are more general and fundamental than others. The course in General Biology (201,

202) is the most general one given; it not only serves as an introduction to all other courses in the Department, but it presents a brief but broad survey of the principal methods and results of work in all fields of Biology and is especially suited to the needs of those who can take only one course in Biology, but who feel that some knowledge of life and its processes is an essential part of a liberal education. To those who can take additional courses, any or all of the other undergraduate courses in Biology are recommended as cultural courses.

Those who elect the Department of Biology in Junior and Senior years are required to take the following courses:

Chemistry { 103, 104 or 201, 202 } and { 303, 304 or 303, 302 }

General Biology 201, 202.

Botany 303, 304.

Osteology 305, Invertebrate Zoölogy 306.

Vertebrate Anatomy and Embryology 401, 402.

Histology 403, 404.

Physiology 407 { Palaeontology 406, or Physiology 408 }

2. *Preparation for Medicine and other Biological Professions.* The more advanced courses in biology are cultural, but they also lay broad foundations for the study of medicine, sanitation, hygiene, physical culture, scientific agriculture, forestry or other biological professions.

Biology is now required for admission to the best medical schools. In addition to this requirement, which may be met by courses 201, 202, it is desirable that prospective students of medicine should obtain a broader acquaintance with biology as a whole than is possible in a medical school, where work is highly specialized and technical.

Those who propose to study medicine are strongly recommended to take the courses indicated below in Freshman and Sophomore years, and to elect the Department of Biology in Junior and Senior years.

FRESHMAN YEAR:—Physics 101, 102, or Chemistry 103, 104.

SOPHOMORE YEAR:—Chemistry 201, 202, or Physics 201, 202.
General Biology 201, 202.

JUNIOR YEAR:—Chemistry 303, 302.
Botany 303, 304.
Osteology 305.
Invertebrate Zoölogy 306.

SENIOR YEAR:—Vertebrate Anatomy and Embryology 401, 402.
Histology 403, 404.
Physiology 407, 408.

3. *Teaching and Research.* The graduate courses in Biology are intended primarily for those who propose to engage in teaching or research and may lead to the degrees of A.M. or Ph.D. In general the undergraduate courses are prerequisite to the graduate courses. Candidates for higher degrees are expected to show a broad general knowledge of biology as a whole, and a comprehensive and detailed knowledge of some one main division of it, such as Botany, Zoölogy, or Physiology.

UNDERGRADUATE COURSES

201, 202. General Biology. Lectures, laboratory work, and recitations. An introduction to the fundamental properties of living things, their functions, structures, classification, habits, life-histories, and evolution. Selected forms are studied in the laboratory as illustrating the chief principles and generalizations of bi-

ology. Reference books: Sedgwick and Wilson: *General Biology;* Hegner: *Introduction to Zoölogy.* Sophomore course, for A.B., B.S. and Litt.B. students, both terms, 3 hours a week. Prerequisite course, General Chemistry 103, 104, or its equivalent. Prerequisite to the subsequent courses in Biology. Professor Conklin and Dr. Cary, assisted by Professors Rankin and Dahlgren.

303, 304. Botany. Practical work in the field and laboratory, lectures and recitations. An introduction to the general principles of plant life. Besides the structure and functions of plants, their taxonomy and their relation to their environment will be studied, use being made of the facilities offered by the grounds of the University. Curtis: *Nature and Development of Plants;* Bergen and Davis: *Principles of Botany.* Junior course, both terms, 3 hours a week. Professor Rankin.

305. Comparative Osteology. Ontogeny and comparative structure of the skeletons of the different classes of vertebrates. Exercises in descriptive work. Each student must prepare a thesis on a skeleton specially assigned for his study. Flower: *Osteology of the Mammalia;* Reynolds: *The Vertebrate Skeleton;* monographs on the skull, the shoulder-girdle, human anatomy. Junior course, first term, 3 hours a week. Prerequisite course: Sophomore course in Biology. Professor Farr.

306. Invertebrate Zoölogy. Lectures and laboratory work on selected phyla of Invertebrates. Hertwig-Kingsley: *Manual of Zoölogy;* Drew: *Invertebrate Zoölogy.* Junior course, second term, 3 hours a week, Prerequisite course, General Biology 201, 202. Dr. Cary.

*401. Comparative Anatomy of Vertebrates. Lecture and laboratory course. Lectures on the comparative anatomy of the organ systems of vertebrates, and dissection of the following forms: Amphioxus, the dogfish, the pigeon, and a mammal. Marshall and Hurst: *Practical Zoölogy*. Reference books: Wilder: *History of the Human Body;* Kingsley: *Vertebrate Zöology;* Wiedersheim: *Vergleichende Anatomie der Wirbelthiere*. Senior course, first term, 3 hours a week. Prerequisite courses: Sophomore and Junior courses in Biology. Professor McClure and Mr. Silvester.

*402. Vertebrate Embryology. Lecture and laboratory course. A comparative study of the development of vertebrates. Hertwig: *Textbook of Embryology;* McMurrich: *The Development of the Human Body*. Senior course, second term, 3 hours a week. Prerequisite course: Comparative Anatomy 401. Professor McClure and Mr. Silvester.

*403. Histology. A study of protoplasm, the cell, and the tissue as they underlie animal and vegetable life. Required text-book: Dahlgren and Kepner: *Principles of Animal Histology*. Reference books: F. T. Lewis: *Stohr's Text Book of Histology;* Schneider: *Histologie der Thiere;* Wilson: *The Cell in Development and Inheritance*. Senior course, first term, 3 hours a week. Prerequisite course: Biology 201, 202. Professor Dahlgren.

*404. Advanced Histology, and Neurology. The comparative Histology of the nervous tissues and neuroglia; an outline of the structure of several important types of nervous systems including the vertebrate type; and work on several other special groups of tissues. Practice in microscopical technic. Thesis. Required

text-books: Dahlgren and Kepner: *The Principles of Animal Histology;* J. B. Johnson: *The Nervous System of Vertebrates.* Senior course, second term, 3 hours a week. Professor Dahlgren.

*406. Vertebrate Palaeontology. Lectures and laboratory work on fossil vertebrates. Smith-Woodward: *Vertebrate Paleontology;* Zittel: *Handbuch der Paleontologie.* Senior course, second term, 3 hours a week. Prerequisite courses: Biology 201, 202, and Osteology 305. Professors Scott and Farr.

*407, *408. General Physiology. Lectures and laboratory work. An introduction to the phenomena exhibited by living matter. The substances of which organisms are composed will be studied and their role in the functioning of the cell discussed. The general physiology of muscle and nerve tissue, of the digestive tract (including absorption, nutrition, secretion and excretion) and of the circulatory system (including respiration) will then be taken up, followed by an account of the coördinate activities of the nervous system, reflexes, tropisms, and the phenomena of reproduction, growth and regeneration. Howell's *Text Book of Physiology.* Senior course, both terms, 3 hours a week. Prerequisite course: Biology 201, 202. Dr. Harvey, assisted by Mr. Wardwell.

GRADUATE COURSES

While such of the undergraduate courses as are marked with an asterisk in the preceding pages may be taken by graduates, the courses outlined below are intended only for graduates. Any of the following courses will be given if applied for by any duly qualified graduate student.

501. Cytology. Lectures, laboratory and research work on protoplasm; the structures and functions of cells;

nuclear and cell division; origin and maturation of the germ cells. First term, 3 hours a week. Alternates with course 517 [1913-1914]. Professor Conklin.

502. Ontogenesis. Lectures, laboratory and research work on the fertilization, cleavage and promorphology of the egg; phenomena of differentiation; problems of experimental embryology; the cellular basis of heredity and evolution. Second term, 3 hours a week. Alternates with course 518 [1913-1914]. Professor Conklin.

503. Comparative Histology and Histogenesis. Studies of supporting, nutritive, excretory, respiratory and several other groups of tissues, including their origin and development; repair, regeneration and metamorphosis. Lectures, laboratory and research work. First term, 3 hours a week. Professor Dahlgren.

504. Histology of the Kinetic and Nerve Tissues. Comparative studies of the organs and tissues which produce light, heat, motion and electricity; the tissues of nervous sensation, communication and stimulation; the organization of nerve tissues in several animal forms. Lectures, laboratory and research work. Second term, 3 hours a week. Professor Dahlgren.

505. Morphology of the Organ Systems of Vertebrates. Conferences, laboratory, and research work on the comparative anatomy and development of the organ systems of vertebrates. About 3,000 anatomical preparations and an embryological collection of about 500 series are at present available for reference and study in connection with this course. First term, 3 hours a week. Professor McClure.

506. Special Problems of Vertebrate Anatomy. Conferences, laboratory, and research work. This course is

designed to place the student in a position to comprehend the main problems of vertebrate morphology and completes the study of the comparative anatomy and development of the organ systems of the anamnia and amniota. Second term, 3 hours a week. Professor McClure.

507. The Development of Plant Life. Studies in the structure, life-history and taxonomy of various groups of plants. First term, 3 hours a week. Professor Rankin.

508. Systematic Botany of the Vascular Plants. Structure as related to description and classification. Exercises in plant analysis, description and classification. The characters of the larger families of Angiosperms. Second term, 3 hours a week. Professor Rankin.

510. Theories of Evolution. A history of the doctrine of evolution, with discussion of the theories which have been proposed to explain the modes and factors of development. Second term, 3 hours a week. Professor Scott.

511, 512. (Geology 511, 512.) Vertebrate Palaeontology. Lectures and laboratory work on the morphology and evolution of fossil vertebrates. Both terms, 3 or more hours a week. Professors Scott and Farr.

513, 514. Physical Chemistry of the Cell. An application of the principles of physical chemistry to physiological problems. The role of diffusion, osmotic pressure, electrolytic dissociation, reaction velocity, catalytic action and surface tension in organisms, the properties of colloids, the effect of salts on cells, and the permeability of cells and tissues will be studied in considerable detail. Based on Philip's *Physical Chemistry*, and Hoeber's *Physikalische Chemie der Zelle*

und Gewebe, 3d Ed. Both terms, 3 hours a week. Dr. Harvey.

515, 516. Morphology and Physiology of the Central Nervous System. A series of conferences with graduate students, together with assignments of problems and direction of research work in the field of Neuro-biology. Both terms, number of hours indefinite. Dr. Paton.

517, 518. Normal and Experimental Embryology. A study of the principles of development and of embryonic differentiation. The work is both observational and experimental and includes a study of normal life histories as well as experimental studies on the factors of differentiation and development The most important books and original publications dealing with the subject are assigned for study. Both terms, 3 hours a week. Alternates with course 501, 502. [1912-1913.] Professor Conklin.

519, 520. Preparation of Biological Compounds. The isolation and purification of typical proteins, lipoids, carbohydrates and extractives from plant and animal tissues. Open to men having some experience in Biological Chemistry. Hawk's *Practical Physiological Chemistry*, 4th Ed. Both terms, 3 or more hours a week. Dr. Harvey.

PUBLIC LECTURES

The study of human activities in relation to Educational and Social Problems. Occasional lectures open to all members of the University. Dr. Paton.

BIOLOGICAL SEMINARY AND JOURNAL CLUB

An organization of the instructors and graduate students of the department, which meets weekly throughout the

academic year for the presentation of the results of original work, reports upon assigned topics, and reviews of recent biological literature.

THE NATURAL SCIENCE ASSOCIATION

An organization composed of the instructors and graduate students of the Departments of Biology and Geology, and of other residents of Princeton especially interested in the natural sciences. Meetings are held once or twice a month, at which time papers of general interest are presented and discussed. Lectures are also given by members of the association and by naturalists from a distance, which are open to the public.

BUILDINGS, FACILITIES, ETC.

The Biological Department is housed in the east half of Guyot Hall, which was erected in 1909 at a cost of about $425,000. This building is situated at the southeast corner of the campus on the southerly slope below the Palmer Physical Laboratory, and beyond it fields, woods and brooks extend down to Lake Carnegie, thus affording unrivaled opportunities for biological gardens and vivaria.

The inside dimensions of the building are 288 feet long and 56 feet wide, with a south extension 63 feet long by 35 feet wide. Its central section has a basement and four stories, and the ends and extension have three and two stories respectively. With a cubical content of about 1,250,000 cubic feet it has a total serviceable floor space of 85,146 square feet.

The Departments of Biology and Geology occupy approximately equal portions of the building, Biology having the eastern and Geology the western end, and certain rooms are used in common; i. e., the museum, the large lecture room, the general library and reading room. The museum

occupies the entire first story, having a height of 18 feet, and, with its gallery along the south side of the central section, affords about 19,300 square feet of floor space. The lecture room, central in the basement, with 210 seats, has brilliant natural and artificial illumination, and is provided with all appurtenances needed for conducting lecture courses and meetings of scientific societies. The library, centrally located on the second floor, has a reading room space of 25 x 25 feet and lateral stacks holding the working libraries of the biological and geological sciences, with capacity for about ten thousand volumes.

The laboratories are arranged in ten separate suites, each suite as a rule accommodating a distinct subject, and five such suites are in each department. In addition there are rooms for graduate students and for investigators, seminary rooms, machine shops, curatorial, preparation, and store rooms, and finely equipped quarters for photographic work. Special rooms are designed for seismographical and meteorological stations. Excluding several rooms used for janitorial and other purposes, 103 rooms are devoted to the work of the scientific departments.

VIVARIA

The study of living plants and animals is a most important part of Biology, and unusual facilities are here offered for such study. In addition to the natural advantages of the situation, afforded by the presence, in the immediate vicinity of the Laboratory, of fields, woods, brooks, Lake Carnegie and the canal, especial preparations have been made for keeping under experimental and observational conditions a considerable variety of animals and plants. The Vivarium is a separate building with glass roof and large concrete aquaria; the latter have an aggregate area of nearly four hundred square feet, one half of which

is devoted to sea-water and the other half to fresh-water. In addition there are rooms with suitable cages for keeping insects, amphibians, reptiles, birds and mammals; also private research rooms, photographic rooms and pump rooms. Adjoining the building are flying cages for birds, runways for mammals, and a greenhouse for plants. Near the Vivarium a biological pond has been formed by damming up a brook, and various cages and retreats will be established as they are needed along the brook and in the woods where many animals may be kept and studied under natural conditions.

MUSEUMS AND COLLECTIONS

The Zoölogical Collections are especially rich in osteological and ornithological material. The former includes a large number of mounted and disarticulated skeletons of fishes, reptiles, birds and mammals. The collections of mounted and unmounted bird skins are especially large, including some sixteen thousand individuals, representing very completely the avifauna of New Jersey, and in part that of North America, Europe, Indo-Asia, Australia, and South America. These collections are supplemented by some four thousand sets of eggs, most of them in nests. The collection of Invertebrata includes a complete series of specimens prepared by the Zoölogical Station at Naples, as well as a large number of corals and shells of mollusks.

The Morphological Museum contains about three thousand preparations, illustrating the comparative anatomy of vertebrates. This collection, which consists of dissections and corrosions, is being increased constantly at the rate of about three hundred preparations a year, all of which are prepared in the laboratory by the Curator and his assistants.

The Histological Collection is located on the second floor of the building and consists of some thirty thousand

mounted microscopical specimens illustrating the various forms of tissues of many different animals; some five thousand specimens are stored in paraffin blocks.

The Botanical Collections are arranged on the third floor and include, besides certain illustrative specimens, models and charts, a Herbarium of mounted plants, classified according to Engler and Prantl's *Pflanzenfamilien*. The Herbarium includes a local collection, representing the New Jersey flora, of four thousand sheets; some forty thousand sheets of plants from different sections of the United States, from South America, Europe, Asia; and ten thousand sheets of mosses, recently acquired from Dr. Per Dusen of Sweden.

The Palaeontological Collections are particularly rich and valuable and include large series of Tertiary fossils from the western part of the United States, and from Patagonia.

THE BIOLOGICAL LABORATORIES

The Biological Laboratories are located in the east half of Guyot Hall and comprise, in addition to the museums, the library, laboratories, research rooms, and seminary rooms for Zoölogy, Physiology and Botany.

The Zoölogical and Anatomical Laboratories include five class rooms, equipped as laboratory-lecture rooms, seven private research rooms, two preparation rooms, a chemical room, two photographic rooms, an artist's room and six store rooms.

The Physiological Laboratories comprise one large laboratory-lecture room, two smaller laboratories, two private research rooms, a photographic room and a shop; these rooms closely adjoin the animal rooms in the sub-basement and Vivarium.

The Botanical Laboratories include, at present, two laboratory-lecture rooms, four private rooms and the herbarium room. A greenhouse and vivarium afford, at all seasons, a considerable variety of land, fresh-water, and marine plants for study. It is hoped that in the near future the extensive grounds south of Guyot Hall may be laid out as a botanical garden and arboretum.

The Palaeontological Laboratories are part of the Geological equipment and are found in the west half of the building.

LIBRARY

The Biological Library consists of about three thousand volumes. It contains sets of about eighty of the principal biological periodicals, as well as standard reference books and monographs. Through the generosity of Mr. Charles W. McAlpin, of the class of 1888, several hundred volumes are added to it each year.

PUBLICATIONS

Reprints of scientific articles published by members of the Biological Department are collected and issued in volumes under the general title, *"Contributions from the Biological Laboratories of Princeton University."*

ADMISSION TO THE GRADUATE SCHOOL

Admission to the Graduate School on diploma is granted to those who possess a Bachelor's degree from Princeton University, or from other institutions maintaining a similar standard in distinctively liberal studies for the Bachelor's degree. An applicant for admission whose undergraduate course is regarded as unsatisfactory or deficient may, with the permission of the Faculty Committee on the Graduate School, be admitted to graduate standing while making up

his deficiencies by undergraduate work, or he may be required to enroll himself as an undergraduate. The regulation regarding admission of graduates to undergraduate standing as "Students Pursuing Partial Courses" is given below.*

All graduate students, whether graduates of Princeton or of another institution, are required to apply for admission at the office of the Dean of the Graduate School before October first of each year, and those who present themselves for the first time must submit to the Dean their diplomas and such other credentials as may be required. Graduates of other universities than Princeton are required to pay a matriculation fee of five dollars.

Immediately after admission every graduate student, including graduate students of the previous year, shall register and report his courses at the office of the Registrar.

FEES

All graduate students, except Fellows, shall pay to the Treasurer the sum of five dollars for each course each term. The total maximum charge is not to exceed twenty dollars a term. Extra charges will be made for certain laboratory courses, the amount to depend on the nature of the course pursued.

DEGREES

The degrees given for graduate study are: Master of Arts and Doctor of Philosophy.

Master of Arts

The degree of Master of Arts may be conferred only

*Students in the Theological Seminary, or other properly qualified persons, may be admitted to one or more undergraduate courses in the University, paying $16 per course each term. Such students shall be entered as undergraduates in the Catalogue under the caption "Students Pursuing Partial Courses."

upon those who hold a bachelor's degree in the liberal arts and sciences from this or another approved college who shall also have devoted at least one year exclusively to resident graduate study in the University under the care of the Faculty, passing examinations upon the studies pursued; or shall have taken graduate courses in the University involving at least three hours a week each term for four terms and passed satisfactory examinations upon these courses, and on such extra reading as may be assigned. The fee for the degree is ten dollars, to be paid to the Treasurer of the University before the candidate enters his last examinations. Every candidate for the Master's degree in one year is expected to take throughout the year at least three graduate courses unless another arrangement is permitted by the Faculty Committee on the Graduate School.

Every candidate for the Master's degree shall announce to the Faculty Committee on the Graduate School, at least eight months before the degree can be conferred, the subjects which he intends to pursue. These subjects shall be such as to form a consistent and well coördinated body of studies, and shall be subject to the approval of the Faculty Committee on the Graduate School.

Doctor of Philosophy

Subject to the regulations hereinafter stated, the degree of Doctor of Philosophy may be conferred upon any Bachelor of Princeton University, or of another approved institution, provided he has spent at least two years exclusively in study for the degree. It should be clearly understood that two years is the minimum period required and that in all but the rarest cases three or more years will be found necessary. One year must be spent in residence at Princeton.

Regulations

Candidacy.—Admission to the Graduate School does not necessarily imply admission to candidacy for a higher degree. A graduate student who desires to become a candidate for the Doctor's degree must make formal application to the Faculty Committee on the Graduate School to be admitted to candidacy at least as early as the beginning of the academic year in which he proposes to present himself for the final examination. He must designate on his application the subject in which he proposes to do his work. This application for candidacy must be endorsed by the Department in which the subject of study lies and must include a satisfactory certificate of the candidate's ability to use French and German as instruments of research. The application, thus endorsed, will be submitted to the Faculty Committee on the Graduate School for final action, which shall then be reported to the University Faculty.

Subjects of Study.—The subjects of study in which the University offers graduate instruction are as follows:

Philosophy	English
History	Mathematics
Politics	Astronomy
Economics	Physics
Art and Archaeology	Chemistry
Classics	Biology
Romanic Languages	Geology
Germanic Languages	

Before offering himself for the final examination the candidate is expected to have acquired a broad general knowledge of the subject which he has chosen and a comprehensive and detailed knowledge of some one main division of it. In certain cases, however, the candidate may, on the

recommendation of the Department in which his subject lies and with the approval of the Faculty Committee on the Graduate School, substitute for a main division of his subject a like division of a germane subject; or he may be required to take additional work outside his subject.

Candidates for the Doctor's degree are also required to take at some time during their period of graduate study a series of twenty weekly lectures on the general trend of philosophical and scientific thought, to be given, with assigned collateral reading, by a member of the Department of Philosophy.

The Thesis.—The candidate shall present to the Department in which his work chiefly lies a thesis on some topic in the special field of his study. If the thesis is accepted by the Department, as giving evidence of high attainment and the power of independent research, the candidate will be recommended by the Department to the Faculty Committee on the Graduate School for admission to the final examination. This recommendation must be accompanied by a statement of the amount and character of the graduate work done and by the formal approval of the thesis.

The Examination.—Examinations for the Doctor's degree are conducted orally in the presence of the Faculty and cannot be divided. A written examination may precede the oral examination if the examiners so desire.

A candidate who passes the examination must print his thesis and deposit 100 copies of it in the University Library. A satisfactory guaranty of the delivery of these copies must be furnished before the conferring of the degree.

Fees.—Those who apply for the degree shall pay the Treasurer of the University a fee of sixty dollars, in two instalments of thirty dollars, the first to be paid when the candidate is enrolled and the second when he sends in his thesis.

UNIVERSITY FELLOWSHIPS AND SCHOLARSHIPS

These fellowships were founded by subscription and endowment and were intended by the founders to encourage study and promote original research in the several departments to which they are assigned. They are distinguished from the College fellowships by being open to the graduates of any American College, while the appointments are made, not by competitive examination, but by a comparison of the records presented by the applicants as to their previous collegiate standing, capacity, and character.

The Porter Ogden Jacobus Fellowship

Established in 1905 by the generosity of Mrs. Clara Cooley Jacobus. This fellowship will be conferred upon that regularly enrolled student in any department of the graduate school, who, in the judgment of the University Faculty, shall have evinced the highest scholarly excellence in his graduate work during the year. The appointee to this fellowship receives the income from an endowment of $25,000 and is expected to devote himself exclusively to study under the direction of the Faculty.

The Charlotte Elizabeth Procter Fellowships

These fellowships are established on an endowment of three hundred thousand ($300,000.00) dollars, given in memory of Charlotte Elizabeth Procter by her son. The terms of the fellowships are as follows:

1. The fellowships shall be known as "The Charlotte Elizabeth Procter Fellowships", and the holders thereof shall be exempt from tuition fees.

2. The fellowships are open only to unmarried men who are graduates of not more than six years' standing and who hold the Bachelor's degree in distinctively liberal studies

from Princeton University or from some other institution maintaining a similar standard for the Bachelor's degree.

3. Appointment is to be made by vote of the University Faculty on nomination by the Dean of the Graduate School after consultation with the full professors in the department interested.

4. The tenure of each fellowship is one academic year, subject to re-appointment for not more than two years longer, except on evidence of extraordinary ability and upon unanimous vote of the University Faculty.

5. The fellowships are not to be allocated to separate departments but are open to all the departments conducting graduate work in the Liberal Arts and Scienes.

6. Every Fellow appointed on this Foundation shall reside in the buildings of the Graduate College, unless dispensed therefrom by the Dean of the Graduate School, and shall devote himself to advanced study to the exclusion of tutoring, teaching, lecturing or any other occupation or employment.

7. In case the conduct or work of any Fellow is unsatisfactory, the tenure of his fellowship may be terminated by the University Faculty.

8. The stipend of each fellowship shall be one thousand ($1,000.00) dollars annually, and no fellowship may be divided.

9. The income of the Foundation is to be applied to maintaining as many fellowships, each yielding one thousand ($1,000.00) dollars annually, as eighty per cent of the income will warrant. All income in excess of eighty per cent shall be applied first, to maintaining the principal of the Foundation, and then to re-investment for the purpose of increasing the stipend of the fellowships in amounts of one hundred ($100.00) dollars each, as rapidly as eighty per cent of such re-investment will permit.

PROVIDED, HOWEVER, that whenever the stipend of such fellowships amounts to fifteen hundred ($1500.00) dollars each per year, thereafter no further increase in the stipend shall be made, but additional fellowships of fifteen hundred ($1500.00) dollars shall be founded as rapidly as said eighty per cent of such re-investment will allow. All excess of income remaining at the end of each fiscal year is to be applied to the increase of the capital fund.

Ten fellowships, each on a stipend of $1000, are available for 1913-14 on this foundation.

CLASS OF 1877 UNIVERSITY FELLOWSHIP IN BIOLOGY

This fellowship pays to the holder $400 per annum.

FRANCIS HINTON MAULE BIOLOGICAL FELLOWSHIP

This fellowship was founded in 1901 by Mr. and Mrs. Francis I. Maule as a memorial of their son, Francis Hinton Maule, who was a student in the University during the years 1895-98. It is conferred by appointment of the faculty and pays the holder the income of $10,000.

GORDON MACDONALD FELLOWSHIP

This fellowship, at present unassigned to any department, was established in 1908 by Mr. James Speyer as a memorial of his friend and partner, Gordon Macdonald. The stipend is about $400.

CLASS OF 1883 UNIVERSITY FELLOWSHIPS

In June, 1910, the class of 1883 contributed the sum of $30,000 to establish two University Fellowships with an income of not less than $600 each; the two fellowships to be awarded by preference in the Departments of Politics, Physics, Chemistry, Biology, or Geology.

Theodore Cuyler Graduate Scholarship

This scholarship was founded by the late C. C. Cuyler of the class of 1879, and was constituted as a graduate scholarship in 1909. It pays the holder $200.

Graduate Scholarships

Other graduate scholarships, with a stipend of $150, may be granted from time to time.

FELLOWSHIP REGULATIONS

The University fellowships are subject to the following regulations:

1. A Fellow must devote himself to study under the direction of the department in which the fellowship is provided. But any Fellow resident in Princeton may be called upon occasionally to give instruction in his department.

2. A Fellow is not ordinarily permitted to give private tuition.

3. The fellowships are to be held for one year, but in cases of special merit they may be continued for a longer period by recommendation of the department and sanction of the Faculty.

4. The candidates shall be graduates possessing a satisfactory Bachelor's diploma in liberal studies from an accredited American college. An application should be accompanied with evidence of the qualifications of the applicant to pursue an independent course of study and investigation in the department concerned.

5. Appointment shall be made by the Faculty upon recommendation of the professors in the department interested, and of the Faculty Committee on the Graduate School, and shall be announced at Commencement.

6. All requests for fellowship or scholarship application blanks should be addressed to the Dean of the Graduate

School, and all applications should be in the hands of the Dean of the Graduate School on or before March 15th, the appointees to hold their positions for a year from the following September. Applications received later than March 15th may be considered in special cases, and to fill vacancies.

THE GRADUATE COLLEGE

The new buildings of the Graduate College are approaching completion and will be ready for the reception of graduate students on Wednesday, September 24th, 1913, the opening day of the coming academic year. Detailed information regarding the rooms and prices is furnished in a separate pamphlet which will be mailed on request. Application for admission to residence or for the separate pamphlet of information should be made to the Dean of the Graduate School.

The group of buildings, now in process of erection, consists of Thomson College, the gift of the late Mrs. J. R. Thomson Swan; Procter Hall, the gift of William Cooper Procter of the Class of 1883 in memory of his parents; the South Tower, the gift of M. Taylor Pyne of the Class of 1877; Wyman House, contributed by the Estate of Isaac C. Wyman; and the Cleveland Memorial Tower in memory of Ex-President Grover Cleveland, erected out of popular contributions collected by the Cleveland Monument Association.

The endowments of the Graduate College include the Fellowship Fund of $300,000 given by William Cooper Procter of the Class of 1883 and the bequests under the will of Isaac C. Wyman of the Class of 1848.

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OFFICIAL REGISTER

OF

PRINCETON UNIVERSITY

VOLUME V MARCH 15, 1914 NUMBER 7

Department of Biology

ANNOUNCEMENT FOR
1914-1915

Published by Princeton University
PRINCETON, NEW JERSEY

Illinois State Laboratory of Natural History,
URBANA, ILLINOIS, U. S. A.

OFFICIAL REGISTER OF PRINCETON UNIVERSITY

[*Entered as second-class matter, December 23, 1909, at the Post Office at Princeton, N. J., under the Act of July 16, 1894.*]

Issued twice a month during December, January, February, March, and April, and monthly in May and August.

These publications include:

The Catalogue of the University.

The Undergraduate Announcement.

The Reports of the President and the Treasurer.

The Descriptive Booklet.

The June Freshman Entrance Examination Papers.

The Announcements of the several Departments, relating to the work of the next year. These are made as accurate as possible, but the right is reserved to make such changes in detail as circumstances may require.

The current number of any of these publications may be obtained by application to the Secretary of the University, Princeton, New Jersey.

PRINCETON UNIVERSITY

Department of Biology

UNDERGRADUATE AND GRADUATE COURSES,
MUSEUM, LABORATORIES, HIGHER DEGREES,
FELLOWSHIPS, THE GRADUATE COLLEGE

ANNOUNCEMENT FOR
1914-1915

Published by Princeton University
1914

CALENDAR

1914

Sept. 23. First term begins.

Sept. 24, 3 P. M. Formal opening exercises.

Sept. 30. Last day for enrolment of graduate students at the office of the Dean of the Graduate School.

Nov. 25, 1.30 P. M.—Nov. 30, 10.30 A. M. Thanksgiving recess.

Nov. 26. Thanksgiving Day.

Dec. 23, 1.30 P. M. Christmas vacation begins.

1915

Jan. 7, 10.30 A. M. Christmas vacation ends.

Feb. 11. Second term begins.

March 15. Last day for receiving applications for Fellowships and Graduate Scholarships.

March 31, 1.30 P. M.—April 6, 10.30 A. M. Spring recess.

June 13. Baccalaureate Sunday.

June 14. Commencement meeting of the Board of Trustees. Annual meetings of the Literary Societies. Class Day.

June 15. 168th Annual Commencement. Alumni Trustee Election. Alumni luncheon.

FACULTY

JOHN GRIER HIBBEN, PH.D., LL.D., LITT.D., *President.*

ANDREW FLEMING WEST, PH.D., LL.D., HON. D.LITT. (Oxon.), *Dean of the Graduate School.*

HENRY BURCHARD FINE, PH.D., LL.D., *Dean of the Departments of Science.*

WILLIAM FRANCIS MAGIE, PH.D., *Dean of the Faculty.*

HOWARD MCCLENAHAN, E.E., M.S., LL.D., *Dean of the College.*

WILLIAM BERRYMAN SCOTT, PH.D., LL.D., *Blair Professor of Geology.*

WALTER MEAD RANKIN, PH.D., *Professor of Biology, Secretary of the Department of Biology.*

CHARLES FREEMAN WILLIAMS MCCLURE, SC.D., *Class of* 1877 *Professor of Zoölogy.*

EDWIN GRANT CONKLIN, PH.D., SC.D., *Professor of Biology, Chairman of the Department of Biology.*

ULRIC DAHLGREN, A.B., M.S., *Professor of Biology.*

MARCUS STULTS FARR, SC.D., *Assistant Professor, Preceptor in Geology.*

CHARLES FREDERICK SILVESTER, *Assistant in Anatomy, Curator of the Museum of Zoölogy.*

LEWIS ROBINSON CARY, PH.D., *Instructor in Biology.*

EDMUND NEWTON HARVEY, PH.D., *Instructor in Physiology.*

STEWART PATON, M.D., *Lecturer in Biology.*

EDWARD HOWLAND WARDWELL, B.S., *Assistant in Physiology.*

HERBERT GREENLEAF COAR, A.M., *Assistant in Biology.*

LIONEL VALDEMAR SILVESTER, A.B., *Assistant in Botany.*

HERBERT RALPH WERNER, PH.M., *Assistant in Biology.*

FELLOWS, 1913-1914

EDWIN EUSTACE REINKE, A.B., Lehigh University, 1908, Ph.D., Princeton University, 1913, *Charlotte Elizabeth Procter Fellow in Biology.*

LOUIS MAX HICKERNELL, A.B., Allegheny College, 1910, *Fellow in Biology.*

WILLIAM EDWIN HOY, JR., A.B., Franklin and Marshall College, 1911, *Francis Hinton Maule Fellow in Biology.*

Harley Nathan Gould, A.B., Allegheny College 1910, *Fellow in Biology.*

Franklin Pearce Reagan, A.B., Indiana University, 1913, *Class of 1877 Fellow in Biology.*

SCOPE OF THE COURSES IN BIOLOGY

The work of the Department of Biology falls into five subdivisions depending upon the subject matter; these are (1) General Biology, (2) Botany, (3) Physiology, (4) Zoölogy and Animal Morphology, (5) Osteology and Palaeontology.

1. The first of these subdivisions includes courses in General Biology (201, 202), and Theories of Evolution (510).

2. The courses in Botany include at present the following:—General Botany (303, 304), The Development of Plant Life (507), Systematic Botany of the Vascular Plants (508).

3. The following courses are offered in Physiology:—General Physiology (407, 408), Physical Chemistry of the Cell (513, 514), Preparation of Biological Compounds (519, 520).

4. The courses in Zoölogy and Animal Morphology are:—Invertebrate Zoölogy (306), Comparative Anatomy of Vertebrates (401), Vertebrate Embryology (402), Histology (403), Advanced Histology (404), Cytology (501), Ontogenesis (502), Comparative Histology and Histogenesis (503), Histology of Kinetic and Nerve Tissues (504), Morphology of Organ Systems of Vertebrates (505), Special Problems of Vertebrate Anatomy (506), Morphology and Physiology of the Central Nervous Systems (515, 516), Normal and Experimental Embryology (517, 518).

5. The Courses in Palaeontology and Osteology are:—Comparative Osteology (305), Vertebrate Palaeontology (406), Vertebrate Palaeontology (511, 512).

ADMISSION TO COURSES

All undergraduate work in the Department of Biology is elective, though some courses may be taken only in a prescribed sequence. An elementary course in general chemistry is prerequisite to the course in General Biology (201, 202.) This course is open to Sophomores, Juniors and Seniors in all courses; it is prerequisite to all other subjects in the Department except Botany 303,304, which is open to Juniors in all courses. All other undergraduate work in Biology is open to Seniors in all courses, who have had the prescribed prerequisites.

Candidates for the degrees of A.B. and B.S. who elect the Department of Biology for the major work of their Junior and Senior years are required to take not less than two of these courses throughout the Junior year and not less than three throughout the Senior year. Since there are more than three Senior courses offered, some selection must be exercised and it is desirable for a Sophomore about to elect the Department to consult with some of its members as to a proper selection.

Any undergraduate course may be taken by graduate students, but only the advanced courses which are marked with an asterisk in the following list may count as graduate work. The graduate courses are open only to properly qualified graduate students.

CHOICE OF COURSES WITH REFERENCE TO PARTICULAR AIMS

It is recognized that the purposes and needs of different students are various and the selection of courses in Biology should be made with reference to individual requirements. However there are certain general purposes for which certain courses are particularly recommended.

1. *General Culture.* All courses offered by the Department of Biology are cultural courses, dealing with the sci-

ence in a philosophical rather than a technical manner, but among the courses some are more general and fundamental than others. The course in General Biology (201, 202) is the most general one given; it not only serves as an introduction to all other courses in the Department, but it presents a brief but broad survey of the principal methods and results of work in all fields of Biology and is especially suited to the needs of those who can take only one course in Biology, but who feel that some knowledge of life and its processes is an essential part of a liberal education. To those who can take additional courses, any or all of the other undergraduate courses in Biology are recommended as cultural courses.

Those who elect the Department of Biology in Junior and Senior years are required to take the following courses:

Chemistry { 103, 104 / or / 201, 202 } and { 303, 304 / or / 303, 302 }

General Biology 201, 202.

Botany 303, 304.

Osteology 305, Invertebrate Zoölogy 306.

Vertebrate Anatomy and Embryology 401, 402.

Histology 403, 404.

Physiology 407 { Palaeontology 406, / or / Physiology 408 }

2. *Preparation for Medicine and other Biological Professions.* The more advanced courses in biology are cultural, but they also lay broad foundations for the study of medicine, sanitation, hygiene, physical culture, scientific agriculture, forestry or other biological professions.

Biology is now required for admission to the best medical schools. In addition to this requirement, which may be met by courses 201, 202, it is desirable that prospective

students of medicine should obtain a broader acquaintance with biology as a whole than is possible in a medical school, where work is highly specialized and technical. Those who propose to study medicine are strongly recommended to take the courses indicated below in Freshman and Sophomore years, and to elect the Department of Biology in Junior and Senior years.

FRESHMAN YEAR:—Physics 101, 102, or Chemistry 103, 104.

SOPHOMORE YEAR:—Chemistry 201, 202, or Physics 201, 202.
General Biology 201, 202.

JUNIOR YEAR:—Chemistry 303, 304.
Botany 303, 304.
Osteology 305.
Invertebrate Zoölogy 306.

SENIOR YEAR:—Vertebrate Anatomy and Embryology 401, 402.
Histology 403, 404.
Physiology 407, 408.

3. *Teaching and Research.* The graduate courses in Biology are intended primarily for those who propose to engage in teaching or research and may lead to the degrees of A.M or Ph.D. In general the undergraduate courses are prerequisite to the graduate courses. Candidates for higher degrees are expected to show a broad general knowledge of biology as a whole, and a comprehensive and detailed knowledge of some one main division of it, such as Botany, Zoölogy, or Physiology.

UNDERGRADUATE COURSES

201, 202. General Biology. Lectures, laboratory work, and recitations. An introduction to the fundamental properties of living things, their functions, structures,

classification, habits, life-histories, and evolution. Selected forms are studied in the laboratory as illustrating the chief principles and generalizations of biology. Reference books: Sedgwick and Wilson: *General Biology;* Hegner: *Introduction to Zoölogy.* Sophomore elective for students in all courses, both terms, 3 hours a week. Prerequisite course, General Chemistry 103, 104, or its equivalent. Prerequisite to the subsequent courses in Biology. Professor Conklin and Dr. Cary.

303, 304. Botany. Practical work in the field and laboratory, lectures and recitations. An introduction to the general principles of plant life. Besides the structure and functions of plants, their taxonomy and their relation to their environment will be studied, use being made of the facilities offered by the grounds of the University. Curtis: *Nature and Development of Plants;* Bergen and Davis: *Principles of Botany.* Junior course, both terms, 3 hours a week. Professor Rankin.

305. Comparative Osteology. Ontogeny and comparative structure of the skeletons of the different classes of vertebrates. Exercises in descriptive work. Each student must prepare a thesis on a skeleton specially assigned for his study. Flower: *Osteology of the Mammalia;* Reynolds: *The Vertebrate Skeleton;* monographs on the skull, the shoulder-girdle, human anatomy. Junior course, first term, 3 hours a week. Prerequisite course: Sophomore course in Biology. Professor Farr.

306. Invertebrate Zoölogy. Lectures and laboratory work on selected phyla of Invertebrates. Hertwig-Kingsley: *Manual of Zoölogy;* Drew: *Invertebrate Zoölogy.* Junior course, second term, 3 hours a week. Pre-

requisite course, General Biology 201, 202. Dr. Cary.

*401. Comparative Anatomy of Vertebrates. Lecture and laboratory course. Lectures on the comparative anatomy of the organ systems of vertebrates, and dissection of the following forms: the dog-fish and a mammal. Marshall and Hurst: *Practical Zoölogy.* Reference books: Wilder: *History of the Human Body;* Kingsley: *Vertebrate Zoölogy;* Wiedersheim: *Vergleichende Anatomie der Wirbelthiere.* Senior course, first term, 3 hours a week. Prerequisite courses: Sophomore and junior courses in Biology. Professor McClure and Mr. C. F. Silvester.

*402. Vertebrate Embryology. Lecture and laboratory course. A comparative study of the development of vertebrates. Bailey and Miller: *Textbook of Embryology;* McMurrich: *The Development of the Human Body.* Senior course, second term, 3 hours a week. Prerequisite course: Comparative Anatomy 401. Professor McClure and Mr. C. F. Silvester.

*403. Histology. A study of protoplasm, cells, and tissues as they underlie animal and vegetable life. Required textbook: Dahlgren and Kepner: *Principles of Animal Histology.* Reference books: F. T. Lewis: *Stohr's Text Book of Histology;* Schneider: *Histologie der Thiere;* Wilson: *The Cell in Development and Inheritance.* Senior course, first term, 3 hours a week. Prerequisite course: Biology 201, 202. Professor Dahlgren.

*404. Advanced Histology, and Neurology. The comparative Histology of the nervous tissues and neuroglia: an outline of the structure of several important types of nervous systems including the vertebrate type; and work on several other special groups of tissues.

* Also listed as graduate course.

Practice in microscopical technic. Thesis. Required textbooks: Dahlgren and Kepner: *The Principles of Animal Histology;* J. B. Johnson: *The Nervous System of Vertebrates.* Senior course, second term, 3 hours a week. Profesor Dahlgren.

*406. Vertebrate Palaeontology. Lectures and laboratory work on fossil vertebrates. Smith-Woodward; *Vertebrate Palaeontology;* Zittel: *Handbuch der Paleontologie.* Senior course, second term, 3 hours a week. Prerequisite courses: Biology 201, 202, and Osteology 305. Professors Scott and Farr.

*407, *408. General Physiology. Lectures and laboratory work. An introduction to the phenomena exhibited by living matter. The substances of which organisms are composed will be studied and their rôle in the functioning of the cell discussed. The general physiology of muscle and nerve tissue, of the digestive tract (including absorption, nutrition, secretion and excretion) and of the circulatory system (including respiration) will then be taken up, followed by an account of the coördinate activities of the nervous system, reflexes, tropisms, and the phenomena of reproduction, growth and regeneration. Howell's *Text Book of Physiology.* Senior course, both terms, 3 hours a week. Prerequisite course: Biology 201, 202. Dr. Harvey, assisted by Mr. Wardwell.

FINAL SPECIAL HONORS

Juniors and Seniors in the Department of Biology may become candidates for Final Special Honors, in accordance with the general regulations for Final Special Honors printed in the University Catalogue.

1. Candidates for Final Special Honors in Biology must

* Also listed as graduate course.

take the course in General Biology (201, 202) either in their sophomore or junior year.

2. In junior year they must take:

Advanced General Biology (301) (New course for honors candidates); 3 hours a week, 1st term.

Invertebrate Zoology (306); with 3 hours a week supplementary work in reading and laboratory work, 2nd term.

Botany (303, 304); with 3 hours a week supplementary reading and laboratory work, both terms.

3. In senior year they must take two of the following courses:

Comparative Anatomy (401); with 3 hours a week supplementary reading and laboratory work, 1st term. Vertebrate Embryology (402); with 3 hours a week supplementary work, 2nd term.

General Physiology (407, 408); with 3 hours a week supplementary reading and laboratory work, both terms.

Histology (403, 404); with 3 hours a week supplementary reading and laboratory work, both terms.

4. In addition to the supplementary work in connection with each of the courses named, candidates for Final Special Honors in Biology shall read the following works before the close of senior year and pass an oral examination on them:

Darwin, *Origin of Species*
Darwin, *Voyage of the Beagle*
Huxley, *Introduction of Zoölogy*
Huxley, *Man's Place in Nature*
Wallace, *Malay Archipelago*
Beddard, *Geological Distribution*
Locy, *Biology and its Makers*
Kellogg, *Darwinism Today*
Jennings, *Behavior of the Lower Organisms*

Wheeler, *Ants*
Walter, *Genetics*
Davenport, *Heredity in Relation to Eugenics*

GRADUATE COURSES

While such of the undergraduate courses as are marked with an asterisk in the preceding pages may be taken by graduates, the courses outlined below are intended only for graduates. Any of the following courses will be given if applied for by any duly qualified graduate student.

501. Cytology. Lectures, laboratory and research work on protoplasm; the structures and functions of cells; nuclear and cell division; origin and maturation of the germ cells. First term, 3 hours a week. Alternates with course 517. [1915-1916.] Professor Conklin, assisted by Professor Dahlgren.

502. Ontogenesis. Lectures, laboratory and research work on the fertilization, cleavage and promorphology of the egg; phenomena of differentiation; problems of experimental embryology; the cellular basis of heredity and evolution. Second term, 3 hours a week. Alternates with course 518 [1915-1916.] Professor Conklin.

503. Comparative Histology and Histogenesis. Studies of supporting, nutritive, excretory, respiratory and several other groups of tissues, including their origin and development, repair, regeneration and metamorphosis. Lectures, laboratory and research work. First term, 3 hours a week. Professor Dahlgren.

504. Histology of the Kinetic and Nerve Tissues. Comparative studies of the organs and tissues which produce light, heat, motion and electricity; the tissues of nervous sensation, communication and stimulation; the organization of nerve tissues in several animal forms. Lectures, laboratory and research

work. Second term, 3 hours a week. Professor Dahlgren.

505. Morphology of the Organ Systems of Vertebrates. Conferences, laboratory, and research work on the comparative anatomy and development of the organ systems of vertebrates. About 3,000 anatomical preparations and an embryological collection of about 500 series are at present available for reference and study in connection with this course. First term, 3 hours a week. Professor McClure.

506. Special Problems of Vertebrate Anatomy. Conferences, laboratory, and research work. This course is designed to place the student in a position to comprehend the main problems of vertebrate morphology and completes the study of the comparative anatomy and development of the organ systems of the anamnia and amniota. Second term, 3 hours a week. Professor McClure.

507. The Development of Plant Life. Studies in the structure, life-history and taxonomy of various groups of plants. First term, 3 hours a week. Professor Rankin.

508. Systematic Botany of the Vascular Plants. Structure as related to description and classification. Exercises in plant analysis, description and classification. The characters of the larger families of Angiosperms. Second term, 3 hours a week. Professor Rankin.

510. Theories of Evolution. A history of the doctrine of evolution, with discussion of the theories which have been proposed to explain the modes and factors of development. Second term, 3 hours a week. Professor Scott.

511, 512. (Geology 511, 512.) Vertebrate Palaeontology. Lectures and laboratory work on the morphology and evolution of fossil vertebrates. Both terms, 3 or more hours a week. Professors Scott and Farr.

513, 514. Physical Chemistry of the Cell. An application of the principles of physical chemistry to physiological problems. The role of diffusion, osmotic pressure, electrolytic dissociation, reaction velocity, catalytic action and surface tension in organisms, the properties of colloids, the effect of salts on cells, and the permeability of cells and tissues will be studied in considerable detail. Based on Philip's *Physical Chemistry,* and Hoeber's *Physikalische Chemie der Zelle und Gewebe,* 3d Ed. Both terms, 3 hours a week. Dr. Harvey.

515, 516. Morphology and Physiology of the Central Nervous System. A series of conferences with graduate students, together with assignments of problems and direction of research work in the field of Neurobiology. Both terms, number of hours indefinite. Dr. Paton.

517, 518. Normal and Experimental Embryology. A study of the principles of development and of embryonic differentiation. The work is both observational and experimental and includes a study of normal life histories as well as experimental studies on the factors of differentiation and development. The most important books and original publications dealing with the subject are assigned for study. Both terms, 3 hours a week. Alternates with courses 501, 502. [1914-1915.] Professor Conklin.

519, 520. Preparation of Biological Compounds. The isolation and purification of typical proteins, lipoids, carbohydrates and extractives from plant and animal tissues. Open to men having some experience in Biological Chemistry. Hawk's *Practical Physiological Chemistry,* 4th Ed. Both terms, 3 or more hours a week. Dr. Harvey.

NON-DEPARTMENTAL COURSE

*408. History of Modern Science. This is a non-technical course in the development of scientific thought from the time of Copernicus and Galileo to the present. The course runs parallel to the courses in the history of philosophy and of literature and of political and social thought. The character and the influence of the great discoveries in Astronomy, Mechanics, Physics, Chemistry and Biology will be studied by means of lectures and reading. The general purpose of the course is to give both the technical and the non-technical student information and training in the meaning and historical results of scientific investigation in different fields. The course continues the History of Greek Philosophy 407. Senior course, second term, 3 hours a week. Professor Spaulding.

PUBLIC LECTURES

The Study of Human Activities in relation to Educational and Social Problems. Occasional lectures open to all members of the University. Dr. Paton.

BIOLOGICAL SEMINARY AND JOURNAL CLUB

An organization of the instructors and graduate students of the department, which meets weekly throughout the academic year for the presentation of the results of original work, reports upon assigned topics, and reviews of recent biological literature.

BUILDINGS, FACILITIES, ETC.

The Biological Department is housed in the east half of Guyot Hall, which was erected in 1909 at a cost of about $425,000. This building is situated at the southeast corner

* Also listed as graduate course.

of the campus on the southerly slope below the Palmer Physical Laboratory, and beyond it fields, woods and brooks extend down to Lake Carnegie, thus affording unrivaled opportunities for biological gardens and vivaria.

The inside dimensions of the building are 288 feet long and 56 feet wide, with a south extension 63 feet long by 35 feet wide. Its central section has a basement and four stories, and the ends and extension have three and two stories respectively. With a cubical content of about 1,250,000 cubic feet it has a total serviceable floor space of 85,146 square feet.

The Departments of Biology and Geology occupy approximately equal portions of the building, Biology having the eastern and Geology the western end, and certain rooms are used in common; i. e., the museum, the large lecture room, the general library and reading room. The museum occupies the entire first story, having a height of 18 feet, and, with its gallery along the south side of the central section, affords about 19,300 square feet of floor space. The lecture room, central in the basement, with 210 seats, has brilliant natural and artificial illumination, and is provided with all appurtenances needed for conducting lecture courses and meetings of scientific societies. The library, centrally located on the second floor, has a reading room space of 25 x 25 feet and lateral stacks holding the working libraries of the biological and geological sciences, with capacity for about ten thousand volumes.

The laboratories are arranged in ten separate suites, each suite as a rule accommodating a distinct subject, and five such suites are in each department. In addition there are rooms for graduate students and for investigators, seminary rooms, machine shops, curatorial, preparation, and store rooms, and finely equipped quarters for photographic work. Special rooms are designed for seismographical and mete-

orological stations. Excluding several rooms used for janitorial and other purposes, 103 rooms are devoted to the work of the scientific departments.

VIVARIA

The study of living plants and animals is a most important part of Biology, and unusual facilities are here offered for such study. In addition to the natural advantages of the situation, afforded by the presence, in the immediate vicinity of the Laboratory, of fields, woods, brooks, Lake Carnegie and the canal, especial preparations have been made for keeping under experimental and observational conditions a considerable variety of animals and plants. The Vivarium is a separate building with glass roof and large concrete aquaria; the latter have an aggregate area of nearly four hundred square feet, one half of which is devoted to sea-water and the other half to fresh-water. In addition there are rooms with suitable cages for keeping insects, amphibians, reptiles, birds and mammals; also private research rooms, photographic rooms and pump rooms. Adjoining the building are flying cages for birds, runways for mammals, and a greenhouse for plants. Near the Vivarium a biological pond has been formed by damming up a brook, and various cages and retreats will be established as they are needed along the brook and in the woods where many animals may be kept and studied under natural conditions.

MUSEUMS AND COLLECTIONS

The Zoölogical Collections are especially rich in osteological and ornithological material. The former includes a large number of mounted and disarticulated skeletons of fishes, reptiles, birds and mammals. The collections of

mounted and unmounted bird skins are especially large, including some sixteen thousand individuals, representing very completely the avifauna of New Jersey, and in part that of North America, Europe, Indo-Asia, Australia, and South America. These collections are supplemented by some four thousand sets of eggs, most of them in nests. The collection of Invertebrata includes a complete series of specimens prepared by the Zoölogical Station at Naples, as well as a large number of corals and shells of mollusks.

The Morphological Museum contains about three thousand preparations, illustrating the comparative anatomy of vertebrates. This collection, which consists of dissections and corrosions, is being increased constantly at the rate of about three hundred preparations a year, all of which are prepared in the laboratory by the Curator and his assistants.

The Histological Collection is located on the second floor of the building and consists of some thirty thousand mounted microscopical specimens illustrating the various forms of tissues of many different animals; some five thousand specimens are stored in paraffin blocks.

The Botanical Collections are arranged on the third floor and include, besides certain illustrative specimens, models and charts, a Herbarium of mounted plants, classified according to Engler and Prantl's *Pflanzenfamilien*. The Herbarium includes a local collection, representing the New Jersey flora, of four thousand sheets; some forty thousand sheets of plants from different sections of the United States, from South America, Europe, Asia; and ten thousand sheets of mosses, recently acquired from Dr. Per Dusen of Sweden.

The Palaeontological Collections are particularly rich and valuable and include large series of Tertiary fossils from the western part of the United States, and from Patagonia.

THE BIOLOGICAL LABORATORIES

The Biological Laboratories are located in the east half of Guyot Hall and comprise, in addition to the museums, the library, laboratories, research rooms, and seminary rooms for Zoölogy, Physiology and Botany.

The Zoölogical and Anatomical Laboratories include five class rooms, equipped as laboratory-lecture rooms, seven private research rooms, two preparation rooms, a chemical room, two photographic rooms, an artist's room and six store rooms.

The Physiological Laboratories comprise one large laboratory-lecture room, two smaller laboratories, two private research rooms, a photographic room and a shop; these rooms closely adjoin the animal rooms in the sub-basement and Vivarium.

The Botanical Laboratories include, at present, two laboratory-lecture rooms, four private rooms and the herbarium room. A greenhouse and vivarium afford, at all seasons, a considerable variety of land, fresh-water, and marine plants for study. It is hoped that in the near future the extensive grounds south of Guyot Hall may be laid out as a botanical garden and arboretum.

The Palaeontological Laboratories are part of the Geological equipment and are found in the west half of the building.

LIBRARY

The Biological Library consists of about three thousand volumes. It contains sets of about eighty of the principal biological periodicals, as well as standard reference books and monographs. Through the generosity of Mr. Charles W. McAlpin, of the class of 1888, several hundred volumes are added to it each year.

PUBLICATIONS

Reprints of scientific articles published by members of the Biological Department are collected and issued in volumes under the general title, *"Contributions from the Biological Laboratories in Princeton University."*

ADMISSION TO THE GRADUATE SCHOOL

Admission to the Graduate School on diploma is granted to those who possess a Bachelor's degree from Princeton University, or from other institutions maintaining a similar standard in distinctively liberal studies for the Bachelor's degree. An applicant for admission whose undergraduate course is regarded as unsatisfactory or deficient may, with the permission of the Faculty Committee on the Graduate School, be admitted to graduate standing while making up his deficiencies by undergraduate work, or he may be required to enroll himself as an undergraduate. The regulations regarding admission of graduates to undergraduate standing as "Students Pursuing Partial Courses" is given below.*

All graduate students, whether graduates of Princeton or of another institution, are required to apply for admission at the office of the Dean of the Graduate School before October first of each year, and those who present themselves for the first time must submit to the Dean their diplomas and such other credentials as may be required. Graduates of other universities than Princeton are required to pay to the Treasurer a matriculation fee of five dollars.

Immediately after admission every graduate student, in-

*Students in the Princeton Theological Seminary, or other properly qualified persons, may be admitted to one or more undergraduate courses in the University, paying $16. per course each term. Such students shall be entered as undergraduates in the catalogue under the caption "Students Pursuing Partial Courses."

cluding graduate students of the previous year, shall register and report his courses at the office of the Dean of the Graduate School.

FEES

Every graduate student on full time is required to pay an annual tuition fee of thirty dollars, unless he is the holder of a Fellowship or Graduate Scholarship. Every graduate student on part time shall pay an annual tuition fee of fifteen dollars.

No charge for laboratory fees is made to graduate students, but if any Department controlling a laboratory desires to charge for expenses and certifies its desire to the Treasurer, a deposit, the amount of which is to be fixed by the Department concerned, will be required to cover in whole or in part the expense incurred for supplies (subject to rebate in case the actual expense is less than the amount of the deposit).

DEGREES

The following degrees are given for graduate study: Master of Arts and Doctor of Philosophy.

MASTER OF ARTS

The degree of Master of Arts may be conferred only upon those who hold a Bachelor's degree in the liberal arts and sciences from this or another approved college who shall also have devoted at least one year exclusively to resident graduate study in the University under the care of the Faculty, passing examinations upon the studies pursued, or shall have taken graduate courses in the University involving at least three hours a week each term for four terms and passed satisfactory examinations upon these courses, and on such extra reading as may be assigned. The fee for the degree is ten dollars, to be paid to the Treasurer of the University before the candidate enters his last examinations. Every candidate for the Master's degree

in one year is expected to take throughout the year at least three graduate courses unless another arrangement is permitted by the Faculty Committee on the Graduate School.

Every candidate for the master's degree shall announce to the Faculty Committee on the Graduate School, at least eight months before the degree can be conferred, the subjects which he intends to pursue. These subjects shall be such as to form a consistent and well coördinated body of studies, and shall be subject to the approval of the Faculty Committee on the Graduate School.

DOCTOR OF PHILOSOPHY

Subject to the regulations hereinafter stated, the degree of Doctor of Philosophy may be conferred upon any Bachelor of Princeton University, or of another approved institution, provided he has spent at least two years exclusively in study for the degree. It should be clearly understood that two years is the minimum period required and that in all but the rarest cases three or more years will be found necessary. One year must be spent in residence at Princeton.

REGULATIONS

Candidacy.—Admission to the Graduate School does not necessarily imply admission to candidacy for a higher degree. A graduate student who desires to become a candidate for the doctor's degree must make formal application to the Faculty Committee on the Graduate School to be admitted to candidacy at least as early as the beginning of the academic year in which he proposes to present himself for the final examination. He must designate on his application the subject in which he proposes to do his work. This application for candidacy must be endorsed by the Department in which the subject of study lies and must include a satisfactory certificate of the candidate's ability to use French and German as instruments of research. The application

thus endorsed, will be submitted to the Faculty Committee on the Graduate School for final action, which shall then be reported to the University Faculty.

Subjects of Study.—The subjects of study in which the University offers graduate instruction are as follows:

Philosophy	English
History	Mathematics
Politics	Astronomy
Economics	Physics
Art and Archaeology	Chemistry
Classics	Biology
Romanic Languages	Geology
Germanic Languages	

Before offering himself for the final examination the candidate is expected to have acquired a broad general knowledge of the subject which he has chosen and a comprehensive and detailed knowledge of some one main division of it. In certain cases, however, the candidate may, on the recommendation of the Department in which his subject lies and with the approval of the Faculty Committee on the Graduate School, substitute for a main division of his subject a like division of a germane subject; or he may be required to take additional work outside his subject.

Candidates for the Doctor's degree are also required to take at some time during their period of graduate study a series of twenty weekly lectures on the general trend of philosophical and scientific thought, to be given, with assigned collateral reading, by a member of the Department of Philosophy.

The Thesis.—The candidate shall present to the Department in which his work chiefly lies a thesis on some topic in the special field of his study. If the thesis is accepted by the Department, as giving evidence of high attainment

and the power of independent research, the candidate will be recommended by the Department to the Faculty Committee on the Graduate School for admission to the final examination. This recommendation must be accompanied by a statement of the amount and character of the graduate work done and by the formal approval of the thesis.

The Examination.—Examinations for the Doctor's degree are conducted orally in the presence of the Faculty and cannot be divided. A written examination may precede the oral examination if the examiners so desire.

A candidate who passes the examination must print his thesis and deposit 100 copies of it in the University Library. A satisfactory guaranty of the delivery of these copies must be furnished before the conferring of the degree.

Fees.—Those who apply for the degree shall pay the Treasurer of the University a fee of sixty dollars, in two instalments of thirty dollars, the first to be paid when the candidate is enrolled and the second when he sends in his thesis.

UNIVERSITY FELLOWSHIPS

These fellowships were founded by subscription and endowment and are intended to encourage advanced study and promote original research in the several departments to which they are assigned. They are distinguished from the College fellowships by being open to the graduates of any American college, while the appointments are made, not by competitive examinations, but by a comparison of the records presented by the applicants as to their previous collegiate standing, capacity, and character.

The University fellowships are subject to the following regulations:

1. A Fellow must devote himself to study under the direction of the department in which the fellowship is pro-

vided. But any Fellow resident in Princeton may be called upon occasionally to give instruction in his department.

2. A Fellow is not ordinarily permitted to give private tuition.

3. The fellowships are to be held for one year, but in cases of special merit they may be continued for a longer period by recommendation of the department and sanction of the Faculty.

4. The candidates shall be graduates possessing a satisfactory Bachelor's diploma in liberal studies from an accredited American college. An application should be accompanied with evidence of the qualifications of the applicant to pursue an independent course of study and investigation in the department concerned.

5. Appointment shall be made by the Faculty upon recommendation of the professors in the department interested and of the Faculty Committee on the Graduate School, and shall be announced at Commencement.

6. All requests for fellowship or scholarship application blanks should be addressed to the Dean of the Graduate School and all applications should be in the hands of the Dean of the Graduate Schoool on or before March 15, the appointees to hold their positions for a year from the following September. Applications received later than March 15 may be considered in special cases, and to fill vacancies.

ADVANCED UNIVERSITY FELLOWSHIPS

The University Fellowships are divided into two classes, the advanced and the ordinary.

The advanced fellowships include the Jacobus Fellowship and the ten Procter Fellowships. They have an annual stipend of one thousand dollars each, and are assigned only to graduate students of at least one year's standing who have given evidence of unusual ability in their grad-

uate work and of capacity to engage successfully in research.

PORTER OGDEN JACOBUS FELLOWSHIP

Established in 1905 by the generosity of Mrs. Clara Cooley Jacobus. This fellowship will be conferred upon that regularly enrolled student of the graduate school who in the judgment of the University Faculty, shall have evinced the highest scholarly excellence in his graduate work during the year. The appointee to this fellowship receives the income from an endowment of $25,000 and is expected to devote himself exclusively to study under the direction of the Faculty.

THE CHARLOTTE ELIZABETH PROCTER FELLOWSHIPS

These fellowships are established on an endowment of three hundred thousand ($300,000.00) dollars, given in memory of Charlotte Elizabeth Procter by her son. The terms of the fellowships are as follows:

1. The fellowships shall be known as The Charlotte Elizabeth Procter Fellowships, and the holders thereof shall be exempt from tuition fees.

2. The fellowships are open only to unmarried men who are graduates of not more than six years' standing and who hold the Bachelor's degree in distinctively liberal studies from Princeton University or from some other institution maintaining a similar standard for the Bachelor's degree.

3. Appointment is to be made by vote of the University Faculty on nomination by the Dean of the Graduate School after consultation with the full professors in the department interested.

4. The tenure of each followship is one academic year, subject to re-appointment for not more than two years longer, except on evidence of extraordinary ability and upon unanimous vote of the University Faculty.

5. The fellowships are not to be allocated to separate departments but are open to all the departments conducting graduate work in the Liberal Arts and Sciences.

6. Every Fellow appointed on this Foundation shall reside in the buildings of the Graduate College, unless dispensed therefrom by the Dean of the Graduate School, and shall devote himself to advanced study to the exclusion of tutoring, teaching, lecturing or any other occupation or employment.

7. In case the conduct or work of any Fellow is unsatisfactory, the tenure of his fellowship may be terminated by the University Faculty.

8. The stipend of each fellowship shall be one thousand ($1,000.00) dollars annually, and no fellowship may be divided.

9. The income of the Foundation is to be applied to maintaining as many fellowships, each yielding one thousand ($1,000.00) dollars annually, as eighty per cent of the income will warrant. All income in excess of eighty per cent shall be applied first, to maintaining the principal of the Foundation, and then to re-investment for the purpose of increasing the stipend of the fellowships in amounts of one hundred ($100.00) dollars each, as rapidly as eighty per cent of such re-investment will permit.

PROVIDED, HOWEVER, that whenever the stipend of such fellowships amounts to fifteen hundred ($1,500.00) dollars each per year, thereafter no further increase in the stipend shall be made, but additional fellowships of fifteen hundred ($1,500.00) dollars shall be founded as rapidly as said eighty per cent of such re-investment will allow. All excess of income remaining at the end of each fiscal year is to be applied to the increase of the capital fund.

Ten fellowships, each on a stipend of $1,000, are available for 1914-1915 on this foundation.

ORDINARY UNIVERSITY FELLOWSHIPS

The ordinary fellowships regularly have a stipend of five hundred dollars on first appointment, and of six hundred dollars on re-appointment. The number of these fellowships is approximately thirty-five and varies slightly from year to year. Sixteen of them are wholly or partly endowed and the funds needed to supplement the partly endowed fellowships and to add others are derived from university appropriations. Of the endowed fellowships the following are open only to students in the Department of Biology:

Class of 1877 University Fellowship in Biology

This fellowship has an income of $400 per annum.

Francis Hinton Maule Biological Fellowship

This fellowship was founded in 1901 by Mr. and Mrs. Francis I. Maule as a memorial of their son, Francis Hinton Maule, who was a student in the University during the years 1895-98. It is conferred by appointment of the faculty and has an endowment of $10,000.

Students in the Department of Biology are also eligible to the following fellowships:

Gordon Macdonald Fellowship

This fellowship, at present unassigned to any department, was established in 1908 by Mr. James Speyer as a memorial to his friend and partner, Gordon Macdonald. The income from the endowment is about $400.

Class of 1883 University Fellowships

In June, 1910, the Class of 1883 contributed the sum of $30,000 to establish two University Fellowships with an income of not less than $600 each; the two fellowships to

be awarded by preference in the Departments of Politics, Physics, Chemistry, Biology or Geology.

GRADUATE SCHOLARSHIPS

In addition to a number of graduate scholarships yielding one hundred and fifty dollars each and maintained by university appropriation, the following endowed graduate scholarship is open to students in any Department:

THEODORE CUYLER GRADUATE SCHOLARSHIP

This scholarship was founded by the late C. C. Cuyler, of the Class of 1879, and was constituted as a graduate scholarship in 1909. It pays the holder $200.

THE GRADUATE COLLEGE

The new buildings of the Graduate College were ready for occupancy in September 1913, and dedication exercises were held on October 22, 1913. This group of buildings consists of Thomson College, the gift of the late Mrs. J. R. Thomson Swann; Proctor Hall, the gift of William Cooper Procter of the Class of 1883 in memory of his parents; Pyne Tower, the gift of M. Taylor Pyne of the Class of 1877; Wyman House, contributed by the Estate of Isaac C. Wyman; and the Cleveland Memorial Tower in memory of President Grover Cleveland, erected out of popular contributions collected by the Cleveland Monument Association.

The endowments of the Graduate College include the Fellowship Fund of $300,000 given by William Cooper Procter of the Class of 1883 and the bequests under the will of Isaac C. Wyman of the Class of 1848.

The site of this group of buildings is on the crest of a slope in the western portion of the University Campus, two-thirds of a mile distant from Nassau Hall and on that

portion of the revolutionary battlefield of Princeton where the final engagement of the battle occurred. The surrounding grounds have been laid out and planted under the direction of Miss Beatrix Jones.

The body stone of all the buildings is the native bluish argillite with trim of Indiana limestone. The stone floors are of Vermont slate or terrazzo. Gray Germantown stone is used for the quoins of the Cleveland Tower, and buff Kentucky sandstone for the interior of Procter Hall. The woodwork and furniture is entirely in oak, and the window casements are of stone with window frames of metal. The roof is grayish green Vermont slate.

The buildings have been designed and constructed in the perpendicular Gothic style by the architects Cram, Goodhue and Ferguson of Boston in accordance with the plan of Mr. Ralph Adams Cram. The group is formed around a central quadrangle, Thomson College, which measures about two hundred and fifty by two hundred feet, enclosing a court and lawn of about one hundred and seventy by one hundred and thirty feet, and containing suites for over one hundred students, besides the kitchen, service quarters, breakfast rooms, common room and reading room. The buildings are fireproof and are heated and lighted throughout by steam and electricity. All students' rooms are completely furnished, including window-curtains, bedding and bed linen, but not toilet linen. A single suite usually includes a study and a bedroom, with share of a toilet room. A double suite includes a study and two bedrooms, with share of toilet room. In some cases a single suite with exceptionally large study and bedroom is used as a double suite by double furnishing of the study and bedroom. Every study is provided with an electric reading lamp and nearly all the studies have open fireplaces.

Adjoining the main college gate at the southeastern corner

of the quadrangle is the Cleveland Tower, forty feet square and one hundred and seventy-three feet high, containing in its base the vaulted memorial chamber of Indiana limestone, twenty-eight feet square and forty-eight feet high. At the eastern side of this lofty room is built a stone base backed and surmounted by a Gothic arch, where it is hoped a bronze statue of President Cleveland may yet be placed. The following inscription is carved on the arch in severely plain capitals:

IN REMEMBRANCE OF
GROVER CLEVELAND
PRESIDENT OF THE UNITED STATES
PUBLIC OFFICE IS A PUBLIC TRUST

Above the memorial chamber is a large room which is reserved for relics of American history, and above this room is the open bell-chamber. A turret stair leads from the base to the top of the tower.

The southwestern corner of the quadrangle is completed by the Pyne Tower which contains the vestibule hall connecting the common rooms and Procter Hall, the suite for the Master in Residence, the guest rooms, and above this, a large suite in the fourth story. The vestibule hall, constructed entirely of Indiana limestone, has slender lierne vaulting. There is also a large tracery window and fireplace with the motto: *In meditatione mea exardescet ignis.*

Projecting westward from the Pyne Tower is Procter Hall, the dining hall and chief public room of the Graduate College. The interior measures thirty-six by one hundred and eight feet. The floor is of Vermont slate, and the interior walls of buff Kentucky sandstone. The panelling and arching roof are in oak. A visitors' gallery with oak screen stands at the eastern end of the hall. At the western end there is a high oriel window on the south side and a

large fireplace facing it on the north. Back of the high table is the brilliant memorial window in stained glass, designed and executed in the manner of the fourteenth century by Mr. and Mrs. William Willet. The window symbolizes Christian learning. In the lower part is a seated figure of the child Christ, teaching the assembled Doctors in the Temple. Below this is carved the inscription: *Nec vocemini magistri, quia magister vester unus est Christus.* The upper portion contains richly draped figures of the Seven Liberal Arts, standing under an evening sky which deepens in the tracery above into the hues of a night sky with stars. Beneath this scene the following inscription is burnt in the glass: *Qui ad iustitiam erudiunt multos quasi stellae in perpetuas aeternitates.* The portraits hung in Procter Hall have been loaned by Mr. Thomas Shields Clarke of the class of 1882.

Wyman House, the residence of the Dean of the Graduate School, stands adjacent to Procter Hall on the southwest.

RESIDENCE IN THE GRADUATE COLLEGE

The object of the Graduate College buildings is to provide a suitable place of residence for graduate students, where they may have the full advantage of a common life in scholarly surroundings. In order that the privileges of these buildings may be generally available, the prices of residence have been fixed at a minimum rate, so that it will be possible to live there for less than the amount which would usually have to be paid in the village of Princeton. Certain rooms will be reserved particularly for the Jacobus and Procter Fellows, and the other Fellows are expected ordinarily to reside there. Rooms at minimum prices will be reserved for students who do not hold fellowships. The capacity of the building is 112 students.

All applications for admission to residence in the buildings of the Graduate College should be addressed to the Dean of the Graduate School, Princeton University, Princeton, New Jersey. Application blanks will be forwarded on request.

At the time the application blank is filled out each year and sent to the Dean of the Graduate School, a deposit of ten dollars should accompany each application in the form of a cheque, New York draft or money order made payable to the *Treasurer of Princeton University*. This deposit will be credited against the student's bill for residence. In case the application is not granted, this fee of ten dollars will be refunded, but will not be returned in case the application is granted, except as above stated.

Application for residence may be made at any time. So far as practicable, the rooms will be assigned in the order of application and in the order of preference indicated on the application blank. Subsequent changes of rooms will be allowed for good reasons, whenever possible. Unless otherwise definitely arranged, the reservation of rooms is for one academic year of thirty-six weeks, including the Thanksgiving recess and the Easter Recess, but not including the Christmas Vacation.

In case of extended absence or withdrawal from residence in the Graduate College, requests for deductions are to be made to the Treasurer of the University. No deductions are made for temporary absence.

The prices charged for residence in the Graduate College include furnished rooms, light, heat, attendance and board, but not personal laundry. The rooms are divided into six groups, with the following total charges to graduate students, assistants, and instructors, for furnished rooms, board, light, heat and attendance for the academic year of thirty-six weeks:

Group I	$300.00
Group II	$320.00
Group III	$340.00
Group IV	$370.00
Group V	$400.00
Group VI	$450.00

The average weekly residential cost to the student thus ranges from the minimum of $8.33 in Group I to the maximum of $12.50 in Group VI. One person occupying a double suite alone is charged three-fourths of the price for two occupants. Arrangements for members of the Faculty, who desire to reside in the Graduate College, are made at an advance over the graduate students' rates.

Graduate students rooming outside may be admitted to the table and other privileges of the Graduate College, except residence, at the rate of $220.00 for the academic year. Graduate students of the University who are not at the table nor resident in the buildings are invited to avail themselves of the other privileges of the Graduate College. Coupon books for occasional meals are furnished at a moderate cost for the use of the members of the Faculty, the graduate students, and their invited guests, as well as to the Trustees and alumni of the University.

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OFFICIAL REGISTER
OF
PRINCETON UNIVERSITY

VOLUME VI FEBRUARY 23, 1915 NUMBER 10

Department of Biology

ANNOUNCEMENT FOR
1915-1916

Published by Princeton University
PRINCETON, NEW JERSEY

OFFICIAL REGISTER OF PRINCETON UNIVERSITY

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Issued twice a month during December, January, February, March and April, and monthly in May and August.

These publications include:

The Catalogue of the University.

The Undergraduate Announcement.

The Reports of the President and the Treasurer.

The Descriptive Booklet.

The Freshman Entrance Examination Papers.

The Announcements of the several Departments, relating to the work of the next year. These are made as accurate as possible, but the right is reserved to make such changes in detail as circumstances may require.

The current number of any of these publications may be obtained by application to the Secretary of the University, Princeton, New Jersey.

PRINCETON UNIVERSITY

Department of Biology

UNDERGRADUATE AND GRADUATE COURSES,
MUSEUM, LABORATORIES, HIGHER DEGREES,
FELLOWSHIPS, THE GRADUATE COLLEGE

ANNOUNCEMENT FOR
1915-1916

Published by Princeton University
1915

CALENDAR

1915

Sept. 22 First term begins.

Sept. 23, 3 P. M. Formal opening exercises.

Sept. 30. Last day for enrolment of graduate students at the office of the Dean of the Graduate School.

Nov. 24, 1.30 P. M.—Nov. 29, 10.30 A. M. Thanksgiving recess.

Nov. 25. Thanksgiving Day.

Dec. 22, 1.30 P. M. Christmas vacation begins.

1916

Jan. 6, 10.30 A. M. Christmas vacation ends.

Feb. 10. Second term begins.

March 1. Last day for receiving applications for Fellowships and Graduate Scholarships.

April 19, 1.30 P. M.—April 25, 10.30 A. M. Spring recess

June 11. Baccalaureate Sunday.

June 12. Commencement meeting of the Board of Trustees. Annual meetings of the Literary Societies. Class Day.

June 13. 169th Annual Commencement. Alumni Trustee election. Alumni luncheon.

FACULTY

JOHN GRIER HIBBEN, PH.D., LL.D., LITT.D., *President.*
ANDREW FLEMING WEST, PH.D., LL.D., HON. D.LITT. (Oxon.), *Dean of the Graduate School.*
HENRY BURCHARD FINE, PH.D., LL.D., *Dean of the Departments of Science.*
WILLIAM FRANCIS MAGIE, PH.D., *Dean of the Faculty.*
HOWARD MCCLENAHAN, E.E., M.S., LL.D., *Dean of the College.*

WILLIAM BERRYMAN SCOTT, PH.D., LL.D., *Blair Professor of Geology.*
WALTER MEAD RANKIN, PH.D., *Professor of Biology, Secretary of the Department of Biology.*
CHARLES FREEMAN WILLIAMS MCCLURE, SC.D., *Class of* 1877 *Professor of Zoölogy.*
EDWIN GRANT CONKLIN, PH.D., SC.D., *Professor of Biology, Chairman of the Department of Biology.*
ULRIC DAHLGREN, A.B., M.S., *Professor of Biology.*
GEORGE HARRISON SHULL, PH.D., *Professor of Botany.*
MARCUS STULTS FARR, SC.D., *Assistant Professor, Preceptor in Geology.*
STEWART PATON, M.D., *Lecturer in Biology.*
CHARLES FREDERICK SILVESTER, *Assistant in Anatomy, Curator of the Museum of Zoölogy.*
LEWIS ROBINSON CARY, PH.D., *Instructor in Biology.*
EDMUND NEWTON HARVEY, PH.D., *Instructor in Physiology.*

LIONEL VALDEMAR SILVESTER, A.B., *Assistant in Botany.*
HARLEY NATHAN GOULD, A.B., *Assistant in Biology.*
CARL CASKEY SPEIDEL, PH.B., *Assistant in Biology.*
ERNEST ISAAC WERBER, PH.D., *Assistant in Physiology.*

FELLOWS, 1914-1915

SOL FELTE LIGHT, A.B., Park College, 1908, A.M., University of the Philippines, 1913, *Charlotte Elizabeth Procter Fellow.*
WILLIAM EDWIN HOY, JR., A.B., Franklin and Marshall College, 1911, *Fellow in Biology.*
HUBERT BAKER GOODRICH, B.S., Amherst College, 1909, A.M., Columbia University, 1914, *Francis Hinton Maule Fellow in Biology.*
FRANKLIN PEARCE REAGAN, A.B., Indiana University, 1913, *Class of* 1877 *Fellow in Biology.*

SCOPE OF THE COURSES IN BIOLOGY

The work of the Department of Biology falls into five subdivisions depending upon the subject matter; these are (1) General Biology, (2) Botany, (3) Physiology, (4) Zoölogy and Animal Morphology, (5) Osteology and Palaeontology.

1. The first of these subdivisions includes courses in General Biology (201, 202), and Theories of Evolution (510).

2. The courses in Botany include the following: General Botany (303, 304), The Development of Plant Life (507), Systematic Botany of the Vascular Plants (508). Courses by Professor Shull will be announced later.

3. The following courses are offered in Physiology: General Physiology (407, 408), Physical Chemistry of the Cell (513, 514), Preparation of Biological Compounds (519, 520).

4. The courses in Zoölogy and Animal Morphology are: Invertebrate Zoölogy (306), Comparative Anatomy of Vertebrates (401), Vertebrate Embryology (402), Histology (403), Advanced Histology (404), Cytology (501), Ontogenesis (502), Comparative Histology and Histogenesis (503), Histology of Kinetic and Nerve Tissues (504), Morphology of Organ Systems of Vertebrates (505), Special Problems of Vertebrate Anatomy (506), Morphology and Physiology of the Central Nervous Systems (515, 516), Normal and Experimental Embryology (517, 518).

5. The Courses in Palaeontology and Osteology are: Comparative Osteology (305), Vertebrate Palaeontology (406), Vertebrate Palaeontology (511, 512).

ADMISSION TO COURSES

All undergraduate work in the Department of Biology is elective, though some courses may be taken only in a pre-

scribed sequence. An elementary course in general chemistry is prerequisite to the course in General Biology (201, 202). This course is open to sophomores, juniors and seniors in all courses; it is prerequisite to all other subjects in the Department except Botany 303, 304, which is open to juniors in all courses. All other undergraduate work in Biology is open to seniors in all courses, who have had the prescribed prerequisites.

Candidates for the degrees of A.B. and B.S. who elect the Department of Biology for the major work of their junior and senior years are required to take not less than two of these courses throughout the junior year and not less than three throughout the senior year. Since there are more than three senior courses offered, some selection must be exercised and it is desirable for a sophomore about to elect the Department to consult with some of its members as to a proper selection,

Any undergraduate course may be taken by graduate students, but only the advanced courses which are marked with an asterisk in the following list may count as graduate work. The graduate courses are open only to properly qualified graduate students.

CHOICE OF COURSES WITH REFERENCE TO PARTICULAR AIMS

It is recognized that the purposes and needs of different students are various and the selection of courses in Biology should be made with reference to individual requirements. However there are certain general purposes for which certain courses are particularly recommended.

1. *General Culture.* All courses offered by the Department of Biology are cultural courses, dealing with the science in a philosophical rather than a technical manner, but among the courses some are more general and fundamental than others. The course in General Biology (201,

202) is the most general one given; it not only serves as an introduction to all other courses in the Department, but it presents a brief but broad survey of the principal methods and results of work in all fields of Biology and is especially suited to the needs of those who can take only one course in Biology, but who feel that some knowledge of life and its processes is an essential part of a liberal education. To those who can take additional courses, any or all of the other undergraduate courses in Biology are recommended as cultural courses.

Those who elect the Department of Biology in junior and senior years are required to take the following courses:

Chemistry { 103, 104 or 201, 202 } and { 303, 304 or 303, 302 }

General Biology 201, 202.
Botany 303, 304.
Osteology 305, Invertebrate Zoölogy 306.
Vertebrate Anatomy and Embryology 401, 402.
Histology 403, 404.

Physiology 407 { Palaeontology 406, or Physiology 408 }

2. *Preparation for Medicine and other Biological Professions.* The more advanced courses in biology are cultural, but they also lay broad foundations for the study of medicine, sanitation, hygiene, physical culture, scientific agriculture, forestry or other biological professions.

Biology is now required for admission to the best medical schools. In addition to this requirement, which may be met by courses 201, 202, it is desirable that prospective students of medicine should obtain a broader acquaintance with biology as a whole than is possible in a medical school,

where work is highly specialized and technical. Those who propose to study medicine are strongly recommended to take the courses indicated below in freshman and sophomore years, and to elect the Department of Biology in junior and senior years.

FRESHMAN YEAR:—Physics 101, 102, or Chemistry 103, 104.

SOPHOMORE YEAR:—Chemistry 201, 202, or Physics 201, 202.
General Biology 201, 202.

JUNIOR YEAR:—Chemistry 303, 304.
Botany 303, 304.
Osteology 305.
Invertebrate Zoölogy 306.

SENIOR YEAR:—Vertebrate Anatomy and Embryology 401, 402.
Histology 403, 404.
Physiology 407, 408.

3. *Teaching and Research.* The graduate courses in Biology are intended primarily for those who propose to engage in teaching or research and may lead to the degrees of A.M. or Ph.D. In general the undergraduate courses are prerequisite to the graduate courses. Candidates for higher degrees are expected to show a broad general knowledge of biology as a whole, and a comprehensive and detailed knowledge of some one main division of it, such as Botany, Zoölogy, or Physiology.

UNDERGRADUATE COURSES

201, 202. General Biology. Lectures, laboratory work, and recitations. An introduction to the fundamental properties of living things, their functions, structures, classification, habits, life-histories, and evolution. Selected forms are studied in the laboratory as illus-

trating the chief principles and generalizations of biology. Sophomore elective for students in all courses, both terms, 3 hours a week. Prerequisite course, General Chemistry 103, 104, or its equivalent. Prerequisite to the subsequent courses in Biology. Professor Conklin and Dr. Cary.

303, 304. Botany. Practical work in the field and laboratory, lectures and recitations. An introduction to the general principles of plant life. Besides the structure and functions of plants, their taxonomy and their relation to their environment will be studied, use being made of the facilities offered by the grounds of the University. Junior course, both terms, 3 hours a week. Professor Rankin.

305. Comparative Osteology. Ontogeny and comparative structure of the skeletons of the different classes of vertebrates. Exercises in descriptive work. Each student must prepare a thesis on a skeleton especially assigned for his study. Junior course, first term, 3 hours a week. Prerequisite course: Sophomore course in Biology. Professor Farr.

306. Invertebrate Zoology. Lectures and laboratory work on selected phyla of Invertebrates. Junior course, second term, 3 hours a week. Prerequisite course, General Biology 201, 202. Dr. Cary.

*401. Comparative Anatomy of Vertebrates. Lecture and laboratory course. Lectures on the comparative anatomy of the organ systems of vertebrates, and dissection of the following forms: dog-fish and a mammal. Senior course, first term, 3 hours a week. Prerequisite courses: Sophomore and junior courses in Biology. Professor McClure and Mr. C. F. Silvester.

*402. Vertebrate Embryology. Lecture and laboratory

* Also listed as graduate course.

course. A comparative study of the development of vertebrates. Senior course, second term, 3 hours a week. Prerequisite course: Comparative Anatomy 401. Professor McClure and Mr. C. F. Silvester.

*403. Histology. A study of protoplasm, cells, and tissues as they underlie animal and vegetable life; the histology of the fundamental tissues of support, energy production, sensation and conduction. Required textbook: Dahlgren and Kepner: *Principles of Animal Histology.* Senior course, first term, 3 hours a week. Prerequisite course: Biology 201, 202. Professor Dahlgren.

*404. Advanced Histology. The comparative Histology of the tissues of reproduction, assimilation, circulation, excretion and secretion. Practice in microscopical technic. Thesis. Required textbooks: Dahlgren and Kepner: *The Principles of Animal Histology;* Prenant and Bouin: *Traité d'Histologie.* Senior course, second term, 3 hours a week. Professor Dahlgren.

*406. Vertebrate Palaeontology. Lectures and laboratory work on fossil vertebrates. Smith-Woodward: *Vertebrate Palaeontology;* Zittel: *Handbuch der Palaeontologie.* Senior course, second term, 3 hours a week. Prerequisite courses: Biology 201, 202, and Osteology 305. Professors Scott and Farr.

*407, *408. General Physiology. Lectures and laboratory work. An introduction to the phenomena exhibited by living matter. The substances of which organisms are composed will be studied and their rôle in the functioning of the cell discussed. The general physiology of muscle and nerve tissue, of the digestive tract (including absorption, nutrition, secretion and excretion) and of the circulatory system (including

* Also listed as graduate course.

respiration) will then be taken up, followed by an account of the coördinate activities of the nervous system, reflexes, tropisms, and the phenomena of reproduction, growth and regeneration. Howell's *Text Book of Physiology*. Senior course, both terms, 3 hours a week. Prerequisite course: Biology 201, 202. Dr. Harvey, assisted by Dr. Werber.

Note. A new senior course in Botany, open to graduate students, will also be given by Professor Shull.

FINAL SPECIAL HONORS

Juniors and seniors in the Department of Biology may become candidates for Final Special Honors, in accordance with the general regulations for Final Special Honors printed in the University Catalogue.

1. Candidates for Final Special Honors in Biology must take the course in General Biology (201, 202) either in their sophomore or junior year.
2. In junior year they must take:

   Advanced General Biology (301); 3 hours a week, with reading and laboratory work, 1st term.

   Invertebrate Zoölogy (306); with 3 hours a week supplementary work in reading and laboratory work, 2nd term.

   Botany (303, 304); with 3 hours a week supplementary reading and laboratory work, both terms.
3. In senior year they must take two of the following courses:

   Comparative Anatomy (401); with 3 hours a week supplementary reading and laboratory work, 1st term. Vertebrate Embryology (402); with 3 hours a week supplementary work, 2nd term.

   General Physiology (407, 408); with 3 hours a week

supplementary reading and laboratory work, both terms.

Histology (403, 404); with 3 hours a week supplementary reading and laboratory work, both terms.

4. In addition to the supplementary work in connection with each of the courses named, candidates for Final Special Honors in Biology must read the following works before the close of senior year and pass an oral examination on them:

Darwin: *Origin of Species*
Darwin: *Voyage of the Beagle*
Huxley: *Introduction of Zoölogy*
Huxley: *Man's Place in Nature*
Wallace: *Malay Archipelago*
Beddard: *Geological Distribution*
Locy: *Biology and its Makers*
Kellogg: *Darwinism Today*
Jennings: *Behavior of the Lower Organisms*
Wheeler: *Ants*
Walter: *Genetics*
Davenport: *Heredity in Relation to Eugenics*

GRADUATE COURSES

While such of the undergraduate courses as are marked with an asterisk in the preceding pages may be taken by graduates, the courses outlined below are intended only for graduates. Any of the following courses will be given if applied for by any duly qualified graduate student.

501. Cytology. Lectures, laboratory and research work on protoplasm; the structures and functions of cells; nuclear and cell division; origin and maturation of the germ cells. First term, 3 hours a week. Alternates with course 517. [1915-1916.] Professor Conklin.

502. Ontogenesis. Lectures, laboratory and research work on the fertilization, cleavage and promorphology of

the egg; phenomena of differentiation; problems of experimental embryology; the cellular basis of heredity and evolution. Second term, 3 hours a week. Alternates with course 518. [1915-1916.] Professor Conklin.

503. Comparative Histology and Histogenesis. Studies of supporting, nutritive, excretory, respiratory and several other groups of tissues, including their origin and development, repair, regeneration and metamorphosis. Lectures, laboratory and research work. First term, 3 hours a week. Professor Dahlgren.

504. Histology of the Kinetic and Nerve Tissues. Comparative studies of the organs and tissues which produce light, heat, motion, and electricity; the tissues of nervous sensation, communication, and stimulation; the organization of nerve tissues in several animal forms. Lectures, laboratory and research work. Second term, 3 hours a week. Professor Dahlgren.

505. Morphology of the Organ Systems of Vertebrates. Conferences, laboratory, and research work on the comparative anatomy and development of the organ systems of vertebrates. About 3,000 anatomical preparations and an embryological collection of about 1,000 series are at present available for reference and study in connection with this course. First term, 3 hours a week. Professor McClure.

506. Special Problems of Vertebrate Anatomy. Conferences, laboratory, and research work. This course is designed to place the student in a position to comprehend the main problems of vertebrate morphology and completes the study of the comparative anatomy and development of the organ systems of the anamnia and amniota. Second term, 3 hours a week. Professor McClure.

507. The Development of Plant Life. Studies in the structure, life-history and taxonomy of various groups of plants. First term, 3 hours a week. Professor Rankin.

508. Systematic Botany of the Vascular Plants. Structure as related to description and classification. Exercises in plant analysis, description and classification. The characters of the larger families of Angiosperms. Second term, 3 hours a week. Professor Rankin.

510. Theories of Evolution. A history of the doctrine of evolution, with discussion of the theories which have been proposed to explain the modes and factors of development. Second term, 3 hours a week. Professor Scott.

511, 512. (Geology 511, 512.) Vertebrate Palaeontology. Lectures and laboratory work on the morphology and evolution of fossil vertebrates. Both terms, 3 or more hours a week. Professors Scott and Farr.

513, 514. Physical Chemistry of the Cell. An application of the principles of physical chemistry to physiological problems. The role of diffusion, osmotic pressure, electrolytic dissociation, reaction velocity, catalytic action and surface tension in organisms, the properties of colloids, the effect of salt on cells, and the permeability of cells and tissues will be studied in considerable detail. Based on Philip's *Physical Chemistry,* and Hoeber's *Physikalische Chemie der Zelle und Gewebe,* 3d Ed. Both terms, 3 hours a week. Dr. Harvey.

515, 516. Morphology and Physiology of the Central Nervous System. A series of conferences with graduate students, together with assignments of problems and direction of research work in the field of Neurobiology. Both terms, number of hours indefinite. Dr. Paton.

517, 518. Normal and Experimental Embryology. A study of the principles of development and of embryonic differentiation. The work is both observational and experimental and includes a study of normal life histories as well as experimental studies on the factors of differentiation and development. The most important books and original publications dealing with the subject are assigned for study. Both terms, 3 hours a week. Alternates with courses 501, 502. [1916-1917.] Professor Conklin.

519, 520. Preparation of Biological Compounds. The isolation and purification of typical proteins, lipoids, carbohydrates and extractives from plant and animal tissues. Open to men having some experience in Biological Chemistry. Hawk's *Practical Physiological Chemistry,* 4th Ed. Both terms, 3 or more hours a week. Dr. Harvey.

NON-DEPARTMENTAL COURSE

*407. History of Modern Science. This is a non-technical course in the development of scientific thought from the time of Copernicus and Galileo to the present. The course runs parallel to the courses in the history of philosophy and of literature and of political and social thought. The character and the influence of the great discoveries in Astronomy, Mechanics, Physics, Chemistry and Biology will be studied by means of lectures and reading. The general purpose of the course is to give both the technical and the non-technical student information and training in the meaning and historical results of scientific investigation in different fields. Senior course, first term, 3 hours a week. Professor Spaulding.

* Also listed as graduate course.

PUBLIC LECTURES

The Study of Human Activities in relation to Educational and Social Problems. Occasional lectures open to all members of the University. Dr. Paton.

BIOLOGICAL SEMINARY AND JOURNAL CLUB

An organization of the instructors and graduate students of the department, which meets weekly throughout the academic year for the presentation of the results of origiial work, reports upon assigned topics, and reviews of recent biological literature.

BUILDINGS, FACILITIES, ETC.

The Biological Department is housed in the east half of Guyot Hall, which was erected in 1909 at a cost of about $425,000. This building is situated at the southeast corner of the campus on the southerly slope below the Palmer Physical Laboratory, and beyond it fields, woods and brooks extend down to Lake Carnegie, thus affording unrivaled opportunities for biological gardens and vivaria.

The inside dimensions of the building are 288 feet long and 56 feet wide, with a south extension 63 feet long by 35 feet wide. Its central section has a basement and four stories, and the ends and extension have three and two stories respectively. With a cubical content of about 1,250-000 cubic feet it has a total serviceable floor space of 85,146 square feet.

The Departments of Biology and Geology occupy approximately equal portions of the building, Biology having the eastern and Geology the western end, and certain rooms are used in common; i. e., the museum, the large lecture room, the general library and reading room. The museum occupies the entire first story, having a height of 18 feet, and, with its gallery along the south side of the central section, affords about 19,300 square feet of floor space. The

lecture room, central in the basement, with 210 seats, has brilliant natural and artificial illumination, and is provided with all appurtenances needed for conducting lecture courses and meetings of scientific societies. The library, centrally located on the second floor, has a reading room space of 25 x 25 feet and lateral stacks holding the working libraries of the biological and geological sciences, with capacity for about ten thousand volumes.

The laboratories are arranged in ten separate suites, each suite as a rule accommodating a distinct subject, and five such suites are in each department. In addition there are rooms for graduate students and for investigators, seminary rooms, machine shops, curatorial, preparation, and store rooms, and finely equipped quarters for photographic work. Special rooms are designed for seismographical and meteorological stations. Excluding several rooms used for janitorial and other purposes, 103 rooms are devoted to the work of the scientific departments.

VIVARIA

The study of living plants and animals is a most important part of Biology, and unusual facilities are here offered for such study. In addition to the natural advantages of the situation, afforded by the presence, in the immediate vicinity of the Laboratory, of fields, woods, brooks, Lake Carnegie and the canal, especial preparations have been made for keeping under experimental and observational conditions a considerable variety of animals and plants. The Vivarium is a separate building with glass roof and large concrete aquaria; the latter have an aggregate area of nearly four hundred square feet, one half of which is devoted to sea-water and the other half to fresh-water. In addition there are rooms with suitable cages for keeping insects, amphibians, reptiles, birds and mammals; also private research rooms, photographic rooms and pump rooms.

Adjoining the building are flying cages for birds, runways for mammals, and a greenhouse for plants. Near the Vivarium a biological pond has been formed by damming up a brook, and various cages and retreats will be established as they are needed along the brook and in the woods where many animals may be kept and studied under natural conditions.

MUSEUMS AND COLLECTIONS

The Zoölogical Collections are especially rich in osteological and ornithological material. The former includes a large number of mounted and disarticulated skeletons of fishes, reptiles, birds and mammals. The collections of mounted and unmounted bird skins are especially large, including some sixteen thousand individuals, representing very completely the avifauna of New Jersey, and in part that of North America, Europe, Indo-Asia, Australia, and South America. These collections are supplemented by some four thousand sets of eggs, most of them in nests. The collection of Invertebrata includes a complete series of specimens prepared by the Zoölogical Station at Naples, as well as a large number of corals and shells of mollusks.

The Morphological Museum contains about three thousand preparations, illustrating the comparative anatomy of vertebrates. This collection, which consists of dissections and corrosions, is being increased constantly at the rate of about three hundred preparations a year, all of which are prepared in the laboratory by the Curator and his assistants.

The Histological Collection is located on the second floor of the building and consists of some thirty thousand mounted microscopical specimens illustrating the various forms of tissues of many different animals; some five thousand specimens are stored in paraffin blocks.

The Botanical Collections are arranged on the third floor and include, besides certain illustrative specimens, models

and charts, a Herbarium of mounted plants, classified according to Engler and Prantl's *Pflanzenfamilien*. The Herbarium includes a local collection, representing the New Jersey flora, of four thousand sheets; some forty thousand sheets of plants from different sections of the United States, from South America, Europe, and Asia; and ten thousand sheets of mosses, recently acquired from Dr. Per Dusen of Sweden.

The Palaeontological Collections are particularly rich and valuable and include large series of Tertiary fossils from the western part of the United States, and from Patagonia.

THE BIOLOGICAL LABORATORIES

The Biological Laboratories are located in the east hall of Guyot Hall and comprise, in addition to the museums, the library, laboratories, research rooms, and seminary rooms for Zoölogy, Physiology and Botany.

The Zoölogical and Anatomical Laboratories include five class rooms, equipped as laboratory-lecture rooms, seven private research rooms, two preparation rooms, a chemical room, two photographic rooms, an artist's room and six store rooms.

The Physiological Laboratories comprise one large laboratory-lecture room, two smaller laboratories, two private research rooms, a photographic room and a shop; these rooms closely adjoin the animal rooms in the sub-basement and Vivarium.

The Botanical Laboratories include, at present, two laboratory-lecture rooms, four private rooms and the herbarium room. A greenhouse and vivarium afford, at all seasons, a considerable variety of land, fresh-water, and marine plants for study. It is hoped that in the near future the extensive grounds south of Guyot Hall may be laid out as a botanical garden and arboretum.

The Palaeontological Laboratories are part of the Geological equipment and are found in the west half of the building.

LIBRARY

The Biological Library consists of over five thousand volumes. It contains sets of about eighty of the principal biological periodicals, as well as standard reference books and monographs. Through the generosity of Mr. Charles W. McAlpin, of the class of 1888, several hundred volumes are added to it each year.

PUBLICATIONS

Reprints of scientific articles published by members of the Biological Department are collected and issued in volumes under the general title, *"Contributions from the Biological Laboratories in Princeton University."*

ADMISSION TO THE GRADUATE SCHOOL

Admission to the Graduate School on diploma is granted to those who possess a Bachelor's degree from Princeton University, or from other institutions maintaining a similar standard in distinctively liberal studies for the Bachelor's degree. An applicant for admission whose undergraduate course is regarded as unsatisfactory or deficient may, with the permission of the Faculty Committee on the Graduate School, be admitted to graduate standing while making up his deficiencies by undergraduate work, or he may be required to enroll himself as an undergraduate. The regulation regarding admission of graduates to undergraduate standing as "Student Pursuing Partial Courses" is given below.*

* Students in the Princeton Theological Seminary, or other properly qualified persons may be admitted to one or more undergraduate courses in the University, paying $16 per course each term. Such students shall be entered as undergraduates in the catalogue under the caption "Students Pursuing Partial Courses."

All graduate students, whether graduates of Princeton or of another institution, are required to apply for admission at the office of the Dean of the Graduate School before October first of each year, and those who present themselves for the first time must submit to the Dean their diplomas and such other credentials as may be required. Graduates of universities other than Princeton are required to pay to the Treasurer a matriculation fee of five dollars. Immediately after admission every graduate student, including graduate students of the previous year, shall register and report his courses at the office of the Dean of the Graduate School.

FEES

Every graduate student on full time is required to pay an annual tuition fee of thirty dollars, unless he is the holder of a Fellowship or Graduate Scholarship. Every graduate student on part time shall pay an annual tuition fee of fifteen dollars. A library fee of five dollars per year is also charged.

No charge for laboratory fees is made to graduate students, but if any Department controlling a laboratory desires to charge for expenses and certifies its desire to the Treasurer, a deposit, the amount of which is to be fixed by the Department concerned, will be required to cover in whole or in part the expense incurred for supplies (subject to rebate in case the actual expense is less than the amount of the deposit).

DEGREES

The following degrees are given for graduate study: Master of Arts and Doctor of Philosophy.

MASTER OF ARTS

The degree of Master of Arts may be conferred only upon those who hold a Bachelor's degree in the liberal

arts and sciences from this or another approved college who shall also have devoted at least one year exclusively to resident graduate study in the University under the care of the Faculty, passing examinations upon the studies pursued, or shall have taken graduate courses in the University involving at least three hours a week each term for four terms and passed satisfactory examinations upon these courses, and on such extra reading as may be assigned. The fee for the degree is ten dollars, to be paid to the Treasurer of the University before the candidate enters his last examinations. Every candidate for the Master's degree in one year is expected to take throughout the year at least three graduate courses unless another arrangement is permitted by the Faculty Committee on the Graduate School. These courses shall be such as to form a consistent and well coördinated body of studies, and shall be subject to the approval of the Faculty Committee on the Graduate School.

DOCTOR OF PHILOSOPHY

Subject to the regulations hereinafter stated, the degree of Doctor of Philosophy may be conferred upon any bachelor of Princeton University, or of another approved institution, provided he has spent at least two years exclusively in study for the degree. It should be clearly understood that two years is the minimum period required and that in all but the rarest cases three years will be found necessary. One year must be spent in residence at Princeton.

REGULATIONS

Subject of Study. An applicant for the degree of Doctor of Philosophy chooses one of the following subjects of study:

Philosophy	Art and Archaeology
History	Classics
Politics	Romanic Languages
Economics	Germanic Languages

English	Chemistry
Mathematics	Biology
Astronomy	Geology
Physics	

The examination for the degree of Doctor of Philosophy consists of two parts, known as the First Part and the Second Part.

Before offering himself for the First Part of the examination for the Doctor's degree the applicant is expected to have acquired a broad general knowledge of the subject which he has chosen and a comprehensive and detailed knowledge of some one main division of it. In certain cases, however, the applicant may, on the recommendation of the department in which his subject lies and with the approval of the Faculty Committee on the Graduate School, substitute for a main division of his subject a like division of a germane subject; or he may be required to take additional work outside his subject.

Applicants for the Doctor's degree are also required to take at some time during their period of graduate study a series of public lectures on the general trend of philosophical and scientific thought, to be given, with assigned collateral reading, by a member of the Department of Philosophy.

The First Part of the Examination. The First Part of the examination for the Doctor's degree is designed to test the student's mastery of his subject of study and is to be held not earlier than toward the close of the second year of graduate study. This examination may be written or oral, or both, at the discretion of the department which gives the examination.

No applicant for the degree of Doctor of Philosophy is to be enrolled as a candidate until he has satisfactorily sustained the First Part of the examination for the Doctor's degree, as described above, and has shown that he is able to use French and German as instruments of research.

In case the First Part of the examination for the Doctor's degree is not sustained, the applicant may be allowed by permission of the Committee on the Graduate School to present himself for a second trial after the lapse of at least one academic term. If this second trial is unsatisfactory, no further examination will be allowed.

A student who has sustained the First Part of the examination for the Doctor's degree is entitled thereby to be recommended for the degree of Master of Arts.

The Thesis. After the applicant has sustained the First Part of the examination and has been enrolled as a candidate for the Doctor's degree he shall present to the department in which his work chiefly lies a thesis on some topic in the special field of his study.

The Second Part of the Examination. When the thesis has been accepted by the department, as giving evidence of high attainment and the power of independent research, the candidate proceeds to the Second Part of the examination for the Doctor's degree. This is a public oral examination in the field of the thesis and the more comprehensive aspects of the subject of study, and may not be divided.

Granting of the Degree. The Doctor's degree will be granted only after the First Part of the examination for the Doctor's degree has been sustained, the thesis accepted, the Second Part of the examination for the Doctor's degree sustained and arrangements for publication of the thesis completed by the candidate and approved by the Committee on the Graduate School.

One hundred copies of the printed thesis must be deposited in the University Library.

Fees. Those who apply for the degree shall pay to the Treasurer of the University a fee of sixty dollars, in two instalments of thirty dollars, the first to be paid before the applicant presents himself for the First Part of the examination and the second when he sends in his thesis.

UNIVERSITY FELLOWSHIPS

These fellowships were founded by subscription and endowment and are intended to encourage advanced study and promote original research in the several departments to which they are assigned. They are distinguished from the College fellowships by being open to the graduates of any American college, while the appointments are made, not by competitive examination, but by a comparison of the records presented by the applicants as to their previous collegiate standing, capacity, and character.

The University fellowships are subject to the following regulations:

1. A Fellow must devote himself to study under the direction of the department in which the fellowship is provided. But any Fellow resident in Princeton may be called upon occasionally to give instruction in his department.

2. A Fellow is not ordinarily permitted to give private tuition.

3. The fellowships are to be held for one year, but in cases of special merit they may be continued for a longer period by recommendation of the department and sanction of the Faculty.

4. The candidates shall be graduates possessing a satisfactory Bachelor's diploma in liberal studies from an accredited American college. An application should be accompanied with evidence of the qualifications of the applicant to pursue an independent course of study and investigation in the department concerned.

5. Appointment shall be made by the Faculty upon recommendation of the professors in the department interested and of the Faculty Committee on the Graduate School, and shall be announced at Commencement.

6. All requests for fellowship or scholarship application blanks should be addressed to the Dean of the Graduate

School and all applications should be in the hands of the Dean of the Graduate School on or before March 15, the appointees to hold their positions for a year from the following September. Applications received later than March 15 may be considered in special cases, and to fill vacancies.

After the present academic year (1914-15) applications for fellowships and scholarships should be received by the Dean of the Graduate School on or before March 1, and it is expected that official announcement of appointments will be made on April 1, notice of acceptance being required on or before April 15.

ADVANCED UNIVERSITY FELLOWSHIPS

The University Fellowships are divided into two classes. the advanced and the ordinary.

The advanced fellowships include the Jacobus Fellowship and the ten Procter Fellowships. They have an annual stipend of one thousand dollars each, and are assigned only to graduate students of at least one year's standing who have given evidence of unusual ability in their graduate work and of capacity to engage successfully in research.

PORTER OGDEN JACOBUS FELLOWSHIP

Established in 1905 by the generosity of Mrs. Clara Cooley Jacobus. This fellowship will be conferred upon that regularly enrolled student of the graduate school who, in the judgment of the University Faculty, shall have evinced the highest scholarly excellence in his graduate work during the year. The appointee to this fellowship receives the income from an endowment of $25,000 and is expected to devote himself exclusively to study under the direction of the Faculty.

THE CHARLOTTE ELIZABETH PROCTER FELLOWSHIPS

These fellowships are established on an endowment of three hundred thousand ($300,000.00) dollars, given in

memory of Charlotte Elizabeth Procter by her son. The terms of the fellowships are as follows:

1. The fellowships shall be known as The Charlotte Elizabeth Procter Fellowships, and the holders thereof shall be exempt from tuition fees.

2. The fellowships are open only to unmarried men who are graduates of not more than six years' standing and who hold the Bachelor's degree in distinctively liberal studies from Princeton University or from some other institution maintaining a similar standard for the Bachelor's degree.

3. Appointment is to be made by vote of the University Faculty on nomination by the Dean of the Graduate School after consultation with the full professors in the department interested.

4. The tenure of each fellowship is one academic year, subject to re-appointment for not more than two years longer, except on evidence of extraordinary ability and upon unanimous vote of the University Faculty.

5. The fellowships are not to be allocated to separate departments but are open to all the departments conducting graduate work in the Liberal Arts and Sciences.

6. Every Fellow appointed on this Foundation shall reside in the buildings of the Graduate College, unless dispensed therefrom by the Dean of the Graduate School, and shall devote himself to advanced study to the exclusion of tutoring, teaching, lecturing or any other occupation or employment.

7. In case the conduct or work of any Fellow is unsatisfactory, the tenure of his fellowship may be terminated by the University Faculty.

8. The stipend of each fellowship shall be one thousand ($1,000.00) dollars annually, and no fellowship may be divided.

9. The income of the Foundation is to be applied to maintaining as many fellowships, each yielding one thousand ($1,000.00) dollars annually, as eighty per cent of the income will warrant. All income in excess of eighty per cent shall be applied first, to maintaining the principal of the Foundation, and then to re-investment for the purpose of increasing the stipend of the fellowships in amounts of one hundred ($100.00) dollars each, as rapidly as eighty per cent of such re-investment will permit.

PROVIDED, HOWEVER, that whenever the stipend of such fellowships amounts to fifteen hundred ($1500.00) dollars each per year, thereafter no further increase in the stipend shall be made, but additional fellowships of fifteen hundred ($1500.00) dollars shall be founded as rapidly as said eighty per cent of such re-investment will allow. All excess of income remaining at the end of each fiscal year is to be applied to the increase of the capital fund.

Ten fellowships, each on a stipend of $1,000, are available for 1915-1916 on this foundation.

ORDINARY UNIVERSITY FELLOWSHIPS

The ordinary fellowships regularly have a stipend of five hundred dollars on first appointment, and of six hundred dollars on re-appointment. The number of these fellowships is approximately thirty-five and varies slightly from year to year. Sixteen of them are wholly or partly endowed and the funds needed to supplement the partly endowed fellowships and to add others are derived from University appropriations. Of the endowed fellowships of special interest to students in the Department of Biology are those described below:

CLASS OF 1877 UNIVERSITY FELLOWSHIP IN BIOLOGY

This fellowship has an income of $400 per annum.

FRANCIS HINTON MAULE BIOLOGICAL FELLOWSHIP

This fellowship was founded in 1901 by Mr. and Mrs. Francis I. Maule as a memorial of their son, Francis Hinton Maule, who was a student in the University during the years 1895-98. It is conferred by appointment of the faculty and has an endowment of $10,000.

Students in the Department of Biology are also eligible to the following fellowships:

GORDON MACDONALD FELLOWSHIP

This fellowship, at present unassigned to any department, was established in 1908 by Mr. James Speyer as a memorial to his friend and partner, Gordon Macdonald. The income from the endowment is about $400.

CLASS OF 1883 UNIVERSITY FELLOWSHIPS

In June, 1910, the Class of 1883 contributed the sum of $30,000 to establish two University Fellowships with an income of not less than $600 each; the two fellowships to be awarded by preference in the Department of Politics, Physics, Chemistry, Biology or Geology.

GRADUATE SCHOLARSHIPS

In addition to a number of graduate scholarships yielding one hundred and fifty dollars each and maintained by university appropriation, the following endowed graduate scholarship is open to students in any Department.

THEODORE CUYLER GRADUATE SCHOLARSHIP

This scholarship was founded by the late C. C. Cuyler, of the Class of 1879, and was constituted as a graduate scholarship in 1909. It pays the holder $200.

THE GRADUATE COLLEGE BUILDINGS

The new buildings of the Graduate College were ready for occupancy in September, 1913, and dedication exercises were held on October 22, 1913. This group of buildings

consists of Thomson College, the gift of the late Mrs. J. R. Thomson Swann; Procter Hall, the gift of William Cooper Procter of the Class of 1883 in memory of his parents; Pyne Tower, the gift of M. Taylor Pyne of the Class of 1877; Wyman House, contributed by the Estate of Isaac C. Wyman; and the Cleveland Memorial Tower in memory of President Grover Cleveland, erected out of popular contributions collected by the Cleveland Monument Association.

The endowments of the Graduate College include the Fellowship Fund of $300,000 given by William Cooper Procter of the Class of 1883 and the bequests under the will of Isaac C. Wyman of the Class of 1848.

The site of this group of buildings is on the crest of a slope in the western portion of the University Campus, two-thirds of a mile distant from Nassau Hall and on that portion of the revolutionary battlefield of Princeton where the final engagement of the battle occurred. The surrounding grounds have been laid out and planted under the direction of Miss Beatrix Jones.

The body stone of all the buildings is the native bluish argillite with trim of Indiana limestone. The stone floors are of Vermont slate or terrazzo. Gray Germantown stone is used for the quoins of the Cleveland Tower, and buff Kentucky sandstone for the interior of Procter Hall. The woodwork and furniture is entirely in oak, and the window casements are of stone with window frames of metal. The roof is grayish green Vermont slate.

The buildings have been designed and constructed in the perpendicular Gothic style by the architects Cram, Goodhue and Ferguson of Boston in accordance with the plan of Mr. Ralph Adams Cram. The group is formed around a central quadrangle, Thomson College, which measures about two hundred and fifty by two hundred feet, enclosing a court and lawn of about one hundred and seventy by one

hundred and thirty feet, and containing suites for over one hundred students, besides the kitchen, service quarters, breakfast rooms, common room and reading room. The buildings are fireproof and are heated and lighted throughout by steam and electricity. All students' rooms are completely furnished, including window-curtains, bedding and bed linen, but not toilet linen. A single suite usually includes a study and a bedroom, with share of a toilet room. A double suite includes a study and two bedrooms, with share of toilet room. In some cases a single suite with exceptionally large study and bedroom is used as a double suite by double furnishing of the study and bedroom. Every study is provided with an electric reading lamp and nearly all the studies have open fireplaces.

Adjoining the main college gate at the southeastern corner of the quadrangle is the Cleveland Tower, forty feet square and one hundred and seventy-three feet high, containing in its base the vaulted memorial chamber of Indiana limestone, twenty-eight feet square and forty-eight feet high. At the eastern side of this lofty room is built a stone base backed and surmounted by a Gothic arch, where it is hoped a bronze statue of President Cleveland may be placed. The following inscription is carved on the arch in severely plain capitals:

IN REMEMBRANCE OF
GROVER CLEVELAND
PRESIDENT OF THE UNITED STATES
PUBLIC OFFICE IS A PUBLIC TRUST

Above the memorial chamber is a large room which is reserved for relics of American history, and above this room is the open bell-chamber. A turret stair leads from the base to the top of the tower.

The southwestern corner of the quadrangle is completed by the Pyne Tower which contains the vestibule hall con-

necting the common room and Procter Hall, the suite for the Master in Residence, the guest rooms and, above this, a large suite in the fourth story. The vestibule hall, constructed entirely of Indiana limestone, has slender lierne vaulting. There is also a large tracery window and a fireplace with the motto: *In meditatione mea exardescet ignis.*

Projecting westward from the Pyne Tower is Procter Hall, the dining hall and chief public room of the Graduate College. The interior measures thirty-six by one hundred and eight feet. The floor is of Vermont slate, and the interior walls of buff Kentucky sandstone. The panelling and arching roof are in oak. A visitors' gallery with oak screen stands at the eastern end of the hall. At the western end there is a high oriel window on the south side and a large fireplace facing it on the north. Back of the high table is the brilliant memorial window in stained glass, designed and executed in the manner of the fourteenth century by Mr. and Mrs. William Willet. The window symbolizes Christian learning. In the lower part is a seated figure of the child Christ, teaching the assembled Doctors in the Temple. Below this is carved the inscription: *Nec vocemini magistri, quia magister vester unus est Christus.* The upper portion contains richly draped figures of the Seven Liberal Arts, standing under an evening sky which deepens in the tracery above into the hues of a night sky with stars. Beneath this scene the following inscription is burnt in the glass: *Qui ad iustitiam erudiunt multos quasi stellae in perpetuas aeternitates.* The portraits hung in Procter Hall have been loaned by Mr. Thomas Shields Clarke of the class of 1882.

Wyman House, the residence of the Dean of the Graduate School, stands adjacent to Procter Hall on the southwest.

RESIDENCE IN THE GRADUATE COLLEGE

The object of the Graduate College buildings is to provide a suitable place of residence for graduate students, where they may have the full advantage of a common life in scholarly surroundings. In order that the privileges of these buildings may be generally available, the prices of residence have been fixed at a minimum cost, so that it will be possible to live there for less than the amount which would usually have to be paid in the village of Princeton. Certain rooms will be reserved particularly for the Jacobus and Procter Fellows, and the other Fellows are expected ordinarily to reside there. Rooms at minimum prices will be reserved for students who do not hold fellowships. The capacity of the building is 112 students.

All applications for admission to residence in the buildings of the Graduate College should be addressed to the Dean of the Graduate School, Princeton University, Princeton, New Jersey. Application blanks will be forwarded on request.

At the time the application blank is filled out each year and sent to the Dean of the Graduate School, a deposit of ten dollars should accompany each application in the form of a cheque, New York draft or money order made payable to the *Treasurer of Princeton University*. This deposit will be credited against the student's bill for residence. In case the application is not granted, this fee of ten dollars will be refunded, but will not be returned in case the application is granted except as above stated.

Application for residence may be made at any time. So far as practicable, the rooms will be assigned in the order of application and in the order of preference indicated on the application blank. Subsequent changes of rooms will be allowed for good reasons, whenever possible. Unless otherwise definitely arranged, the reservation of rooms is for one academic year of thirty-six weeks, including the Thanksgiving Recess and the Easter Recess, but not including the Christmas Vacation.

In case of extended absence or withdrawal from residence in the Graduate College, requests for deductions are to be made to the Treasurer of the University. No deductions are made for temporary absence.

The prices charged for residence in the Graduate College include furnished rooms, light, heat, attendance and board, but not personal laundry. The rooms are divided into six groups, with the following total charges to graduate students, assistants and instructors, for furnished rooms, board, light, heat and attendance for the academic year of thirty-six weeks:

Group I	$300.00
Group II	$320.00
Group III	$340.00
Group IV	$370.00
Group V	$400.00
Group VI	$450.00

The average weekly residential cost to the student thus ranges from the minimum of $8.33 in Group I to the maximum of $12.50 in Group VI. One person occupying a double suite alone is charged two-thirds of the price for two occupants. Arrangements for members of the Faculty, other than Instructors, who desire to reside in the Graduate College, are made at an advance over the graduate students' rates.

Graduate students rooming outside may be admitted to the table and other privileges of the Graduate College, except residence, at the rate of $230.00 for the academic year. Graduate students of the University who are not at the table nor resident in the buildings are invited to avail themselves of the other privileges of the Graduate College. Coupon books for occasional meals are furnished at a moderate cost for the use of the members of the Faculty, the graduate students, and their invited guests, as well as to the Trustees and alumni of the University.

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Department of Biology

ANNOUNCEMENT FOR
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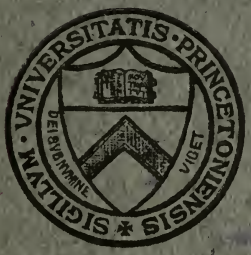

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Issued twice a month during December, January, February, March and April, and monthly in May and September.

These publications include:

The Catalogue of the University.

The Undergraduate Announcement.

The Reports of the President and the Treasurer.

The Descriptive Booklet.

The Freshman Entrance Examination Papers.

The announcements of the several Departments, relating to the work of the next year. These are made as accurate as possible, but the right is reserved to make such changes in detail as circumstances may require.

The current number of any of these publications may be obtained by application to the Secretary of the University, Princeton, New Jersey.

PRINCETON UNIVERSITY

Department of Biology

UNDERGRADUATE AND GRADUATE COURSES,
MUSEUM, LABORATORIES, HIGHER DEGREES,
FELLOWSHIPS, THE GRADUATE COLLEGE

ANNOUNCEMENT FOR
1916-1917

Published by Princeton University
1916

1916

Sept. 26, 3 P. M. Formal opening exercises.

Sept. 30. Last day for enrolment of graduate students at the office of the Dean of the Graduate School.

Oct. 12-14. First part of examination for the degree of Doctor of Philosophy.

Nov. 29, 1.30 P. M.—Dec. 4, 10.30 A. M. Thanksgiving recess.

Nov. 30. Thanksgiving Day.

Dec. 19, 1.30 P. M. Christmas vacation begins.

1917

Jan. 3, 10.30 A. M. Christmas vacation ends.

Feb. 14. Second term begins.

March 1. Last day for receiving applications for Fellowships and Graduate Scholarships.

April 4, 1.30 P. M.—April 10, 10.30 A. M. Spring recess.

May 10-12. First part of examination for the degree of Doctor of Philosophy.

June 17. Baccalaureate Sunday.

June 18. Commencement meeting of the Board of Trustees. Annual meetings of the Literary Societies. Class Day.

June 19. 170th Annual Commencement. Alumni Trustee election. Alumni luncheon.

FACULTY

John Grier Hibben, Ph.D., LL.D., Litt.D., *President.*
Andrew Fleming West, Ph.D., LL.D., Hon. D.Litt. (Oxon.), *Dean of the Graduate School.*
Henry Burchard Fine, Ph.D., LL.D., *Dean of the Departments of Science.*
William Francis Magie, Ph.D., *Dean of the Faculty.*
Howard McClenahan, E.E., M.S., LL.D., *Dean of the College.*

William Berryman Scott, Ph.D., LL.D., *Blair Professor of Geology.*
Walter Mead Rankin, Ph.D., *Professor of Biology, Secretary of the Department of Biology.*
Charles Freeman Williams McClure, Sc.D., *Class of 1877 Professor of Zoölogy.*
Edwin Grant Conklin, Ph.D., Sc.D., *Professor of Biology, Chairman of the Department of Biology.*
Ulric Dahlgren, A.B., M.S., *Professor of Biology.*
George Harrison Shull, Ph.D., *Professor of Botany and Genetics.*
Marcus Stults Farr, Sc.D., *Assistant Professor, Preceptor in Geology.*
Stewart Paton, M.D. *Lecturer in Neuro-Biology.*
Alfred Goldsborough Mayer, Sc.D., *Lecturer in Zoölogy.*
Edmund Newton Harvey, Ph.D., *Assistant Professor of Physiology.*
Charles Frederick Silvester, *Assistant in Anatomy, Curator of the Museum of Zoölogy.*
Lewis Robinson Cary, Ph.D., *Instructor in Biology.*

Harry Hamilton Laughlin, B.S., *Assistant in Genetics.*
Charles Leo Macy, *Assistant in Genetics.*
Amos Henry Hersh, A.M., *Assistant in Biology.*
Elmer Lentz Shaffer, B.S., *Assistant in Biology.*
Carl Caskey Speidel, Ph.B., *Assistant in Biology.*
Raymond Henry Fogler, B.S., *Assistant in Physiology.*

FELLOWS, 1915-1916

Franklin Pearce Reagan, A.B., Indiana University 1913, *Charlotte Elizabeth Procter Fellow.*

HARLEY NATHAN GOULD, A.M., Princeton University, 1914, *Francis Hinton Maule Fellow in Biology.*

EDWARD ELLIOTT MACMORLAND, A.M., University of Missouri, 1915, *Class of 1877 Fellow in Biology.*

SCOPE OF THE COURSES IN BIOLOGY

The work of the Department of Biology falls into five subdivisions depending upon the subject matter; these are (1) General Biology, (2) Botany and Genetics, (3) Physiology, (4) Zoölogy and Animal Morphology, (5) Osteology and Palaeontology.

1. The first of these subdivisions includes courses in General Biology (201, 202), and Theories of Evolution (510).

2. The courses in Botany include the following: General Botany (303, 304), The Development of Plant Life (507), Systematic Botany of the Vascular Plants (508), Genetics (409, 410), Research in Genetics (521, 522).

3. The following courses are offered in Physiology: General Physiology (407, 408), Physical Chemistry of the Cell (513, 514), Preparation of Biological Compounds (519, 520).

4. The courses in Zoölogy and Animal Morphology are: Invertebrate Zoölogy (306), Comparative Anatomy of Vertebrates (401), Vertebrate Embryology (402), Histology (403), Advanced Histology (404), Cytology (501), Ontogenesis (502), Comparative Histology and Histogenesis (503), Histology of Kinetic and Nerve Tissues (504), Morphology of Organ Systems of Vertebrates (505), Special Problems of Vertebrate Anatomy (506), Morphology and Physiology of the Central Nervous Systems (515, 516), Normal and Experimental Embryology (517, 518).

5. The courses in Palaeontology and Osteology are: Comparative Osteology (305), Vertebrate Palaeontology (406), Vertebrate Palaeontology (511, 512).

ADMISSION AND REQUIREMENTS

All undergraduate work in the Department of Biology is elective, though some courses may be taken only in a prescribed sequence. An elementary course in general chemistry must precede or accompany the course in General Biology (201, 202). This course is open to sophomores, juniors and seniors in all courses; it is prerequisite to all other subjects in the Department except Botany 303, 304, which is open to juniors in all courses. All other undergraduate work in Biology is open to seniors in all courses, who have had the prescribed prerequisites.

Candidates for the degree of A.B. or B.S. who elect the Department of Biology for the major work of their junior and senior years are required to take two years of Chemistry and not less than two biological courses throughout the junior year and three throughout the senior year. Since there are more than this number of courses offered, some selection must be exercised and it is desirable for a sophomore about to elect the Department to consult with some of its members as to a proper selection. It is advisable that these courses be taken in the following order:

FRESHMAN YEAR:—Chemistry 103, 104.

SOPHOMORE YEAR:—Physics 201, 202.
General Biology 201, 202.

JUNIOR YEAR:—Chemistry 303, 304.
Botany 303, 304.
Osteology 305.
Invertebrate Zoölogy 306.

SENIOR YEAR:—Anatomy and Embryology 401, 402.
Histology 403, 404.
Palaeontology 406.
Physiology 407, 408.
Genetics 409, 410.

Any undergraduate course may be taken by graduate students, but only the advanced courses which are marked with an asterisk in the following list may count as graduate work. The graduate courses are open only to properly qualified graduate students.

CHOICE OF COURSES WITH REFERENCE TO PARTICULAR AIMS

It is recognized that the purposes and needs of different students are various and the selection of courses in Biology should be made with reference to individual requirements. However, there are certain general purposes for which certain courses are particularly recommended.

1. *General Culture.* All courses offered by the Department of Biology are cultural in that they deal with the science in a philosophical rather than a technical manner, but among the courses some are more general and fundamental than others. The course in General Biology (201, 202) is the most general one given; it not only serves as an introduction to all other courses in the Department, but it presents a brief but broad survey of the principal methods and results of work in all fields of Biology and is especially suited to the needs of those who can take only one course in Biology, but who feel that some knowledge of life and its processes is an essential part of a liberal education. To those who can take additional courses, any or all of the other undergraduate courses in Biology are recommended as of cultural value.

2. *Preparation for Medicine and other Biological Professions.* No "premedical" courses are offered, but the more advanced courses in Biology lay broad foundations for the study of medicine, sanitation, hygiene, physical culture, scientific agriculture, forestry or other biological professions.

Biology is now required for admission to the best medical schools. In addition to this requirement, which may be

met by courses 201, 202, it is desirable that prospective students of medicine should obtain a broader acquaintance with biology as a whole than is possible in a medical school, where work is in the main highly specialized and technical.

3. *Teaching and Research.* The graduate courses in Biology are intended primarily for those who propose to engage in teaching or research and they may lead to the degrees of A.M. or Ph.D. In general the undergraduate courses are prerequisite to the graduate courses. Candidates for higher degrees are expected to show a broad general knowledge of biology as a whole, and a comprehensive and detailed knowledge of some one main division of it, such as Botany, Zoölogy, or Physiology.

UNDERGRADUATE COURSES

201, 202. General Biology. Lectures, laboratory work, and recitations. An introduction to the fundamental properties of living things, their functions, structures, classification, habits, life-histories, and evolution. Selected forms are studied in the laboratory as illustrating the chief principles and generalizations of biology. Sophomore elective for students in all courses, both terms, 3 hours a week. Must be preceded or accompanied by General Chemistry 103, 104, or its equivalent. Prerequisite to the subsequent courses in Biology except Botany 303, 304. Professor Conklin and Dr. Cary.

303, 304. Botany. Practical work in the field and laboratory, lectures and recitations. An introduction to the general principles of plant life. Besides the structure and functions of plants, their taxonomy and their relation to their environment will be studied, use being made of the facilities offered by the grounds of the University. Junior course, both terms, 3 hours a week. Professor Rankin.

305. Comparative Osteology. Ontogeny and comparative structure of the skeletons of the different classes of vertebrates. Exercises in descriptive work. Each student must prepare a thesis on a skeleton especially assigned for his study. Junior course, first term, 3 hours a week. Must be preceded or accompanied by Biology 201, 202. Professor Farr.

306. Invertebrate Zoology. Lectures and laboratory work on selected phyla of invertebrates. Junior course, second term, 3 hours a week. Prerequisite course, General Biology 201. Dr. Cary.

*401. Comparative Anatomy of Vertebrates. Lecture and laboratory course. Lectures on the comparative anatomy of the organ systems of vertebrates, and dissection of the following forms: dog-fish and a mammal. Senior course, first term, 3 hours a week. Prerequisite courses: sophomore and junior courses in Biology. Professor McClure and Mr. Silvester.

*402. Vertebrate Embryology. Lecture and laboratory course. A comparative study of the development of vertebrates. Senior course, second term, 3 hours a week. Prerequisite course: Comparative Anatomy 401. Professor McClure and Mr. Silvester.

*403. Histology. A study of protoplasm, cells, and tissues as they underlie animal and vegetable life; the histology of the fundamental tissues of support, energy production, sensation and conduction. Senior course, first term, 3 hours a week. Prerequisite course: Biology 201, 202. Professor Dahlgren.

*404. Advanced Histology. The comparative Histology of the tissues of reproduction, assimilation, circulation, excretion and secretion. Practice in microscopical technic. Thesis. Senior course, second term, 3 hours a

* Also listed as a graduate course.

week. Prerequisite course: Histology 403. Professor Dahlgren.

*406. Vertebrate Palaeontology. Lectures and laboratory work on fossil vertebrates. Senior course, second term, 3 hours a week. Prerequisite courses: Biology 201, 202, and Osteology 305. Professors Scott and Farr.

*407, *408. General Physiology. Lectures and laboratory work. An introduction to the phenomena exhibited by living matter. The substances of which organisms are composed will be studied and their rôle in the functioning of the cell discussed. The general physiology of muscle and nerve tissue, of the digestive tract (including absorption, nutrition, secretion and excretion) and of the circulatory system (including respiration) will then be taken up, followed by an account of the coordinate activities of the nervous system, reflexes, tropisms, and the phenomena of reproduction, growth and regeneration. Senior course, both terms, 3 hours a week. Prerequisite course: Biology 201, 202. Professor Harvey, assisted by Mr. Fogler.

*409, *410. Genetics. Lectures, recitations, and laboratory work. The development, variation, modification and inheritance of morphological and physiological characteristics of plants and animals, and the application of the principles of genetics to the improvement of plants, animals, and man. Laboratory work will consist largely of actual research on simple problems calculated to give facility in the collection and analysis of data, and an insight into the principles involved in development, variation and heredity. Well written theses presenting the results of the laboratory work

* Also listed as a graduate course.

will be expected of each student. Senior course, both terms, 3 hours a week. Prerequisite course: Biology 201, 202. Professor Shull and Mr. Laughlin.

FINAL SPECIAL HONORS

Juniors and seniors in the Department of Biology may become candidates for Final Special Honors, in accordance with the general regulations for Final Special Honors printed in the University Catalogue.

1. Candidates for Final Special Honors in Biology must take the course in General Biology (201, 202) either in their sophomore or junior year.
2. In junior year they must take:
   Advanced General Biology (301); 3 hours a week, with reading and laboratory work, 1st term.
   Invertebrate Zoölogy (306); with 3 hours a week supplementary reading and laboratory work, 2nd term.
   Botany (303, 304); with 3 hours a week supplementary reading and laboratory work, both terms.
3. In senior year they must take two of the following courses:
   Comparative Anatomy (401); with 3 hours a week supplementary reading and laboratory work, 1st term. Vertebrate Embryology (402); with 3 hours a week supplementary work, 2nd term.
   General Physiology (407, 408); with 3 hours a week supplementary reading and laboratory work, both terms.
   Histology (403, 404); with 3 hours a week supplementary reading and laboratory work, both terms.
   Genetics (409, 410); with 3 hours a week supplementary reading and laboratory work, both terms.
4. In place of the regular term examinations at the end

of senior year, candidates for Final Special Honors in Biology shall take comprehensive examinations covering the Honors work of both junior and senior years.

5. In addition to the supplementary work in connection with each of the courses named, candidates for Final Special Honors in Biology are expected to read the following works before the close of senior year and to pass an oral examination on them:

Beddard: *Geographical Distribution*
Darwin: *Origin of Species*
Ganong: *The Living Plant*
Huxley: *Man's Place in Nature*
Kellogg: *Darwinism Today*
Locy: *Biology and its Makers*
Mendel: *Experiments in Plant Hybridization*
Wallace: *Malay Archipelago*
Walter: *Genetics*
Weismann: *The Germ Plasm*

GRADUATE COURSES

While such of the undergraduate courses as are marked with an asterisk in the preceding pages may be taken by graduates, the courses outlined below are intended only for graduates. Any of the following courses will be given if applied for by any duly qualified graduate student.

501. Cytology. Lectures, laboratory and research work on protoplasm; the structures and functions of cells; nuclear and cell division; origin and maturation of the germ cells. First term, 3 hours a week. Alternates with course 517. [1917-1918.] Professor Conklin.

502. Ontogenesis. Lectures, laboratory and research work on the fertilization, cleavage and promorphology of

the egg; phenomena of differentiation; problems of experimental embryology; the cellular basis of heredity and evolution. Second term, 3 hours a week. Alternates with course 518. [1917-1918.] Professor Conklin.

503. Comparative Histology and Histogenesis. Studies of supporting, nutritive, excretory, respiratory and several other groups of tissues, including their origin and development, repair, regeneration and metamorphosis. Lectures, laboratory and research work. First term, 3 hours a week. Professor Dahlgren.

504. Histology of the Kinetic and Nerve Tissues. Comparative studies of the organs and tissues which produce light, heat, motion, and electricity; the tissues of nervous sensation, communication, and stimulation; the organization of nerve tissues in several animal forms. Lectures, laboratory and research work. Second term, 3 hours a week. Professor Dahlgren.

505. Morphology of the Organ Systems of Vertebrates. Conferences, laboratory, and research work on the comparative anatomy and development of the organ systems of vertebrates. About 3,000 anatomical preparations and an embryological collection of about 1,000 series are at present available for reference and study in connection with this course. First term, 3 hours a week. Professor McClure.

506. Special Problems of Vertebrate Anatomy. Conferences, laboratory, and research work. This course is designed to place the student in a position to comprehend the main problems of vertebrate morphology and completes the study of the comparative anatomy and development of the organ systems of the anamnia and amniota. Second term, 3 hours a week. Professor McClure.

507. The Development of Plant Life. Studies in the structure, life-history and taxonomy of various groups of plants. First term, 3 hours a week. Professor Rankin.

508. Systematic Botany of the Vascular Plants. Structure as related to description and classification. Exercises in plant analysis, description and classification. The characters of the larger families of Angiosperms. Second term, 3 hours a week. Professor Rankin.

510. Theories of Evolution. A history of the doctrine of evolution, with discussion of the theories which have been proposed to explain the modes and factors of development. Second term, 3 hours a week. Professor Scott.

511, 512. (Geology 511, 512.) Vertebrate Palaeontology. Lectures and laboratory work on the morphology and evolution of fossil vertebrates. Both terms, 3 or more hours a week. Professors Scott and Farr.

513, 514. Physical Chemistry of the Cell. An application of the principles of physical chemistry to physiological problems. The rôle of diffusion, osmotic pressure, electrolytic dissociation, reaction velocity, catalytic action and surface tension in organisms, the properties of colloids, the effect of salt on cells, and the permeability of cells and tissues will be studied in considerable detail. Based on Philip's *Physical Chemistry,* and Hoeber's *Physikalische Chemie der Zelle und Gewebe,* 3d Ed. Both terms, 3 hours a week. Professor Harvey.

515, 516. Morphology and Physiology of the Central Nervous System. A series of conferences with graduate students, together with assignments of problems and direction of research work in the field of Neuro-Biology. Both terms, number of hours indefinite. Dr. Paton.

517, 518. Normal and Experimental Embryology. A study of the principles of development and of embryonic differentiation. The work is both observational and experimental and includes a study of normal life-histories as well as experimental studies on the factors of differentiation and development. Important books and original publications dealing witih the subject are assigned for study. Both terms, 3 hours a week. Alternates with courses 501, 502. [1916-1917.] Professor Conklin.

519, 520. Preparation of Biological Compounds. The isolation and purification of typical proteins, lipoids, carbohydrates and extractives from plant and animal tissues. Open to men having some experience in Biological Chemistry. Matthews: *Physiological Chemistry*. Both terms, 3 or more hours a week. Professor Harvey.

521, 522. Research in Genetics. The investigation of problems in variation and heredity of plants and animals, with assigned readings and conferences. Open to men fully qualified by previous training. Both terms, 3 or more hours a week and extending through the summer season. Professor Shull.

NON-DEPARTMENTAL COURSE

*407. History of Modern Science. This is a non-technical course in the development of scientific thought from the time of Copernicus and Galileo to the present. The course runs parallel to the courses in the history of philosophy and of literature and of political and social thought. The character and the influence of the great discoveries in Astronomy, Mechanics, Physics, Chemistry and Biology will be studied by

* Also listed as a graduate course.

means of lectures and reading. The general purpose of the course is to give both the technical and the non-technical student information and training in the meaning and historical results of scientific investigation in different fields. Senior course, first term, 3 hours a week. Professor Spaulding.

PUBLIC LECTURES

The Study of Human Activities in relation to Educational and Social Problems. Occasional lectures open to all members of the University. Dr. Paton.

Occasional public lectures upon oceanographic and physiological subjects, and also lectures in connection with zoölogical courses upon the embryology, anatomy, physiology, and relationships of coelenterates. Dr. Mayer.

BIOLOGICAL SEMINARY AND JOURNAL CLUB

An organization of the instructors and graduate students of the department, which meets weekly throughout the academic year for the presentation of the results of original work, reports upon assigned topics, and reviews of recent biological literature.

BUILDINGS, FACILITIES, ETC.

The Biological Department is housed in the east half of Guyot Hall, which was erected in 1909 at a cost of about $425,000. This building is situated at the southeast corner of the campus on the southerly slope below the Palmer Physical Laboratory, and beyond it fields, woods and brooks extend down to Lake Carnegie, thus affording unrivaled opportunities for biological gardens and vivaria.

The inside dimensions of the building are 288 feet long

and 56 feet wide, with a south extension 63 feet long by 35 feet wide. Its central section has a basement and four stories, and the ends and extension have three and two stories respectively. With a cubical content of about 1,250-000 cubic feet it has a total serviceable floor space of 85,146 square feet.

The Departments of Biology and Geology occupy approximately equal portions of the building, Biology having the eastern and Geology the western end, and certain rooms are used in common; i.e., the museum, the large lecture room, the general library and reading room. The museum occupies the entire first story, having a height of 18 feet, and, with its gallery along the south side of the central section, affords about 19,300 square feet of floor space. The lecture room, central in the basement, with 210 seats, has brilliant natural and artificial illumination, and is provided with all appurtenances needed for conducting lecture courses and meetings of scientific societies. The library, centrally located on the second floor, has a reading room space of 25×25 feet and lateral stacks holding the working libraries of the biological and geological sciences, with capacity for about ten thousand volumes.

The laboratories are arranged in ten separate suites, each suite as a rule accommodating a distinct subject, and five such suites are in each department. In addition there are rooms for graduate students and for investigators, seminary rooms, machine shops, curatorial, preparation, and store rooms, and finely equipped quarters for photographic work. Special rooms are designed for seismographical and meteorological stations. Excluding several rooms used for janitorial and other purposes, 103 rooms are devoted to the work of the scientific departments.

VIVARIA

The study of living plants and animals is a most important part of Biology, and unusual facilities are here offered for such study. In addition to the natural advantages of the situation, afforded by the presence, in the immediate vicinity of the Laboratory, of fields, woods, brooks, Lake Carnegie and the canal, especial preparations have been made for keeping under experimental and observational conditions a considerable variety of animals and plants. The Vivarium is a separate building with glass roof and large concrete aquaria; the latter have an aggregate area of nearly four hundred square feet and a capacity of about ten thousand gallons, one half of which is devoted to sea-water, and the other half to fresh-water. In addition there are rooms with suitable cages for keeping insects, amphibians, reptiles, birds and mammals; also private research rooms, photographic rooms and pump rooms. Adjoining the building are flying cages for birds, runways for mammals, and glasshouses for plants. Near the Vivarium a biological pond has been formed by damming up a brook, and various cages and retreats will be established as they are needed along the brook and in the woods where many animals may be kept and studied under natural conditions.

MUSEUMS AND COLLECTIONS

The Zoölogical Collections are especially rich in osteological and ornithological material. The former includes a large number of mounted and disarticulated skeletons of fishes, reptiles, birds and mammals. The collections of mounted and unmounted bird skins are especially large, including some sixteen thousand individuals, representing very completely the avifauna of New Jersey, and in part that of North America, Europe, Indo-Asia, Australia, and South America. These collections are supplemented by some four

thousand sets of eggs, most of them in nests. The collection of Invertebrata includes a complete series of specimens prepared by the Zoölogical Station at Naples, as well as a large number of corals and shells of mollusks.

The Morphological Museum contains about three thousand preparations, which consist of dissections and corrosions, illustrating the comparative anatomy of vertebrates.

The Histological Collection is located on the second floor of the building and consists of some thirty thousand mounted microscopical specimens illustrating the various forms of tissues of many different animals; some five thousand specimens are stored in paraffin blocks.

The Botanical Collections are arranged on the third floor and include, besides certain illustrative specimens, models and charts, a Herbarium of mounted plants, classified according to Engler and Prantl's *Pflanzenfamilien*. The Herbarium includes a local collection, representing the New Jersey flora, of four thousand sheets; some forty thousand sheets of plants from different sections of the United States, from South America, Europe, and Asia; and ten thousand sheets of mosses, recently acquired from Dr. Per Dusen of Sweden.

The Palaeontological Collections are particularly rich and valuable and include large series of Tertiary fossils from the western part of the United States, and from Patagonia.

THE BIOLOGICAL LABORATORIES

The Biological Laboratories are located in the east half of Guyot Hall and comprise, in addition to the museums, the library, laboratories, research rooms, and seminary rooms for Zoölogy, Physiology and Botany.

The Zoölogical and Anatomical Laboratories include five class rooms, equipped as laboratory-lecture rooms, seven

private research rooms, two preparation rooms, a chemical room, two photographic rooms, an artist's room and six store rooms.

The Physiological Laboratories comprise one large laboratory-lecture room, two smaller laboratories, two private research rooms, a photographic room and a shop. These rooms closely adjoin the animal rooms in the sub-basement and Vivarium.

The Botanical Laboratory includes two laboratory-lecture rooms, four private rooms and the herbarium room. A glass house and vivarium afford at all seasons a considerable variety of land, fresh-water, and marine plants for study. A greenhouse 22 × 100 feet, with headhouse 15 × 24 feet, has been erected and fully equipped for experimental work in genetics, and about fourteen acres of level land to the south of Guyot Hall have been set apart and specially prepared for the growing of pedigree-cultures.

The Palaeontological Laboratories are part of the Geological equipment and are found in the west half of the building.

LIBRARY

The Biological Library consists of about fourteen thousand volumes. It contains sets of about ninety of the principal biological periodicals, as well as standard reference books and monographs. Through the generosity of Mr. Charles W. McAlpin, of the class of 1888, several hundred volumes are added to it each year.

PUBLICATIONS

Reprints of scientific articles published by members of the Biological Department are collected and issued in volumes under the general title, *"Contributions from the Biological Laboratories in Princeton University."*

ADMISSION TO THE GRADUATE SCHOOL

Applicants who possess a Bachelor's degree from Princeton University, or from other institutions maintaining a similar standard in distinctively liberal studies for the Bachelor's degree, may be admitted to the Graduate School subject to the following regulations:

1. Admission on diploma to the Graduate School is granted to Bachelors of Princeton University whose standing for the undergraduate course is within the first three General Groups. A Bachelor of lower standing may not be admitted unless his average standing in undergraduate studies in the department of his proposed graduate work is higher than the Third Group.

2. The equivalent of this standard is expected of applicants holding the Bachelor's diploma from other colleges and universities.

3. A student of Princeton Theological Seminary may be admitted to the Graduate School if he fulfills the conditions as respects the Bachelor's degree and previous academic standing required of those who are admitted as students giving their full time to the work of the Graduate School. Students of Princeton Theological Seminary whose Bachelor's degree and academic record do not conform to these conditions may be admitted to the Graduate School if they are graduate students of the Seminary or if they have completed the first year of the Seminary course.

4. In every case the further question of eligibility for a higher degree will be determined by the academic record of the applicant and his ascertained ability to pursue graduate studies.

The regulation regarding admission of graduates to undergraduate standing as Students Pursuing Partial Courses is given below.*

All graduate students, whether graduates of Princeton or of another institution, are required to apply for admission at the office of the Dean of the Graduate School before October first of each year, and those who present themselves for the first time must submit to the Dean their diplomas and such other credentials as may be required.

Immediately after admission every graduate student, including graduate students of the previous year, shall register and report his courses at the office of the Dean of the Graduate School.

FEES

Graduates of universities other than Princeton are required to pay to the Treasurer a matriculation fee of five dollars. A diploma fee of five dollars is charged every graduate student coming up for a higher degree. Every graduate student on full time, except holders of Jacobus or Procter Fellowships, is required to pay an annual tuition fee of one hundred dollars. Every graduate student on part time, except part-time assistants in Princeton University, is required to pay an annual tuition fee of forty dollars.

No charge for laboratory fees is made to graduate students, but if any department controlling a laboratory desires to charge for expenses and certifies its desire to the Treasurer, a deposit, the amount of which is to be fixed by the department concerned, will be required to cover in whole or in part the expense incurred for supplies (subject to rebate in case the actual expense is less than the amount of the deposit).

* Students in the Princeton Theological Seminary, or other properly qualified persons may be admitted to one or more undergraduate courses in the University, paying $17.50 per course each term. Such students shall be entered as undergraduates in the catalogue under the caption "Students Pursuing Partial Courses."

DEGREES

The following degrees are given for graduate study: Master of Arts and Doctor of Philosophy.

MASTER OF ARTS

The degree of Master of Arts may be conferred only upon those who hold a Bachelor's degree in the liberal arts and sciences from this or another approved college who shall also have devoted at least one year exclusively to resident graduate study in the University under the care of the Faculty, passing examinations upon the studies pursued, or shall have taken graduate courses in the University involving at least three hours a week each term for four terms and passed satisfactory examinations upon these courses, and on such extra reading as may be assigned. Every candidate for the Master's degree in one year is expected to take throughout the year at least three graduate courses unless another arrangement is permitted by the Faculty Committee on the Graduate School. These courses shall be such as to form a consistent and well coördinated body of studies, and shall be subject to the approval of the Faculty Committee on the Graduate School.

DOCTOR OF PHILOSOPHY

Subject to the regulations hereinafter stated, the degree of Doctor Philosophy may be conferred upon any bachelor of Princeton University, or of another approved institution, provided he has spent at least two years exclusively in study for the degree. It should be clearly understood that two years is the minimum period required and that in all but the rarest cases three years will be found necessary. One year must be spent in residence at Princeton.

REGULATIONS

Subject of Study. An applicant for the degree of Doctor of Philosophy chooses one of the following subjects of study:

Philosophy	English
History	Mathematics
Politics	Astronomy
Economics	Physics
Art and Archaeology	Chemistry
Classics	Biology
Romanic Languages	Geology
Germanic Languages	

The examination for the degree of Doctor of Philosophy consists of two parts, known as the First Part and the Second Part.

Before offering himself for the First Part of the examination for the Doctor's degree the applicant is expected to have acquired a broad general knowledge of the subject which he has chosen and a comprehensive and detailed knowledge of some one main division of it. In certain cases, however, the applicant may, on the recommendation of the department in which his subject lies and with the approval of the Faculty Committee on the Graduate School, substitute for a main division of his subject a like division of a germane subject; or he may be required to take additional work outside his subject.

Applicants for the Doctor's degree are also required to take at some time during their period of graduate study a series of public lectures on the general trend of philosophical and scientific thought, to be given, with assigned collateral reading, by a member of the Department of Philosophy.

The First Part of the Examination. The First Part of the examination for the Doctor's degree is designed to test

the student's mastery of his subject of study and is to be held not earlier than toward the close of the second year of graduate study. This examination may be written or oral, or both, at the discretion of the department which gives the examination.

No applicant for the degree of Doctor of Philosophy is to be enrolled as a candidate until he has satisfactorily sustained the First Part of the examination for the Doctor's degree as described above, and has shown that he is able to use French and German as instruments of research.

In case the First Part of the examination for the Doctor's degree is not sustained, the applicant may be allowed by permission of the Committee on the Graduate School to present himself for a second trial after the lapse of at least one academic term. If this second trial is unsatisfactory, no further examination will be allowed.

A student who has sustained the First Part of the examination for the Doctor's degree is entitled thereby to be recommended for the degree of Master of Arts.

The Thesis. After the applicant has sustained the First Part of the examination and has been enrolled as a candidate for the Doctor's degree he shall present to the department in which his work chiefly lies a thesis on some topic in the special field of his study.

The Second Part of the Examination. When the thesis has been accepted by the department, as giving evidence of high attainment and the power of independent research, the candidate proceeds to the Second Part of the examination for the Doctor's degree. This is a public oral examination in the field of the thesis and the more comprehensive aspects of the subject of study, and may not be divided.

Granting of the Degree. The Doctor's degree will be granted only after the First Part of the examination for the Doctor's degree has been sustained, the thesis accepted,

the Second Part of the examination for the Doctor's degree sustained, and arrangements for publication of the thesis completed by the candidate and approved by the Committee on the Graduate School.

One hundred copies of the printed thesis must be deposited in the University Library.

UNIVERSITY FELLOWSHIPS

These fellowships were founded by subscription and endowment and are intended to encourage advanced study and promote original research in the several departments to which they are assigned. They are distinguished from the College fellowships by being open to the graduates of any American college, while the appointments are made, not by competitive examination, but by a comparison of the records presented by the applicants as to their previous collegiate standing, capacity, and character.

The University fellowships are subject to the following regulations:

1. A Fellow must devote himself to study under the direction of the department in which the fellowship is provided. But any Fellow resident in Princeton may be called upon occasionally to give instruction in his department.

2. A Fellow is not ordinarily permitted to give private tuition.

3. The fellowships are to be held for one year, but in cases of special merit they may be continued for a longer period by recommendation of the department and sanction of the Faculty.

4. The candidates shall be graduates possessing a satisfactory Bachelor's diploma in liberal studies from an accredited American college. An application should be accompanied with evidence of the qualifications of the ap-

plicant to pursue an independent course of study and investigation in the department concerned.

5. Appointment shall be made by the Faculty upon recommendation of the professors in the department interested and of the Faculty Committee on the Graduate School, and shall be announced at Commencement.

6. All requests for fellowship or scholarship application blanks should be addressed to the Dean of the Graduate School and all applications should be in the hands of the Dean of the Graduate School on or before March 1, the appointees to hold their positions for a year from the following September. Applications received later than March 1 may be considered in special cases, and to fill vacancies.

ADVANCED UNIVERSITY FELLOWSHIPS

The University Fellowships are divided into two classes, the advanced and the ordinary.

The advanced fellowships include the Jacobus Fellowship and the ten Procter Fellowships. They have an annual stipend of one thousand dollars each, exempt from the charge for tuition, and are assigned only to graduate students of at least one year's standing who have given evidence of unusual ability in their graduate work and of capacity to engage successfully in research.

PORTER OGDEN JACOBUS FELLOWSHIP

Established in 1905 by the generosity of Mrs. Clara Cooley Jacobus. This fellowship will be conferred upon that regularly enrolled student of the graduate school who, in the judgment of the University Faculty, shall have evinced the highest scholarly excellence in his graduate work during the year. The appointee to this fellowship receives the income from an endowment of $25,000 and is

expected to devote himself exclusively to study under the direction of the Faculty.

THE CHARLOTTE ELIZABETH PROCTER FELLOWSHIPS

These fellowships are established on an endowment of three hundred thousand ($300,000.00) dollars, given in memory of Charlotte Elizabeth Procter by her son. The terms of the fellowships are as follows:

1. The fellowships shall be known as The Charlotte Elizabeth Procter Fellowships, and the holders thereof shall be exempt from tuition fees.

2. The fellowships are open only to unmarried men who are graduates of not more than six years' standing and who hold the Bachelor's degree in distinctively liberal studies from Princeton University or from some other institution maintaining a similar standard for the Bachelor's degree.

3. Appointment is to be made by vote of the University Faculty on nomination by the Dean of the Graduate School after consultation with the full professors in the department interested.

4. The tenure of each fellowship is one academic year, subject to re-appointment for not more than two years longer, except on evidence of extraordinary ability and upon unanimous vote of the University Faculty.

5. The fellowships are not to be allocated to separate departments but are open to all the departments conducting graduate work in the Liberal Arts and Sciences.

6. Every Fellow appointed on this Foundation shall reside in the buildings of the Graduate College, unless dispensed therefrom by the Dean of the Graduate School, and shall devote himself to advanced study to the exclusion of tutoring, teaching, lecturing or any other occupation or employment.

7. In case the conduct or work of any Fellow is unsatisfactory, the tenure of his fellowship may be terminated by the University Faculty.

8. The stipend of each fellowship shall be one thousand ($1,000.00) dollars annually, and no fellowship may be divided.

9. The income of the Foundation is to be applied to maintaining as many fellowships, each yielding one thousand ($1,000.00) dollars annually, as eighty per cent of the income will warrant. All income in excess of eighty per cent shall be applied first, to maintaining the principal of the Foundation, and then to re-investment for the purpose of increasing the stipend of the fellowships in amounts of one hundred ($100.00) dollars each, as rapidly as eighty per cent of such re-investment will permit.

PROVIDED, HOWEVER, that whenever the stipend of such fellowships amounts to fifteen hundred ($1500.00) dollars each per year, thereafter no further increase in the stipend shall be made, but additional fellowships of fifteen hundred ($1500.00) dollars shall be founded as rapidly as said eighty per cent of such re-investment will allow. All excess of income remaining at the end of each fiscal year is to be applied to the increase of the capital fund.

ORDINARY UNIVERSITY FELLOWSHIPS

The ordinary fellowships regularly have a stipend of six hundred dollars on first appointment, and of seven hundred dollars on re-appointment, subject to the charge of one hundred dollars for tuition. The number of these fellowships is approximately thirty-five and varies slightly from year to year. Sixteen of them are wholly or partly endowed and the funds needed to supplement the partly endowed fellowships and to add others are derived from University appropriations. Of the endowed fellowships of special interest to students in the Department of Biology are those described below:

CLASS OF 1877 UNIVERSITY FELLOWSHIP IN BIOLOGY

This fellowship has an income of $400 per annum.

FRANCIS HINTON MAULE BIOLOGICAL FELLOWSHIP

This fellowship was founded in 1901 by Mr. and Mrs. Francis I. Maule as a memorial of their son, Francis Hinton Maule, who was a student in the University during the years 1895-98. It is conferred by appointment of the faculty and has an endowment of $10,000.

Students in the Department of Biology are also eligible to the following fellowships:

GORDON MACDONALD FELLOWSHIP

This fellowship, open to students in any department, was established in 1908 by Mr. James Speyer as a memorial to his friend and partner, Gordon Macdonald. The endowment yields about $500 annual income.

CLASS OF 1883 UNIVERSITY FELLOWSHIPS

In June, 1910, the Class of 1883 contributed the sum of $30,000 to establish two University Fellowships with an income of not less than $600 each; the two fellowships to be awarded by preference in the Departments of Politics, Physics, Chemistry, Biology or Geology.

GRADUATE SCHOLARSHIPS

A number of graduate scholarships yielding respectively two hundred and fifty dollars and one hundred dollars each, subject to the charge of one hundred dollars for tuition, are maintained by university appropriation. They are awarded by the Faculty, on the basis of scholarship, upon the recommendation of the Professors in the several departments, and of the Faculty Committee on the Graduate School.

THEODORE CUYLER GRADUATE SCHOLARSHIP

This scholarship, open to students in any department, was founded by the late C. C. Cuyler, of the Class of 1879, and was constituted as a graduate scholarship in 1909. It pays the holder $300, less the charge of one hundred dollars for tuition.

THE GRADUATE COLLEGE BUILDINGS

The buildings of the Graduate College were completed in September, 1913. This group of buildings consists of Thomson College, the gift of the late Mrs. J. R. Thomson Swann; Procter Hall, the gift of William Cooper Procter of the Class of 1883 in memory of his parents; Pyne Tower, the gift of M. Taylor Pyne of the Class of 1877; Wyman House, contributed by the Estate of Isaac C. Wyman; and the Cleveland Memorial Tower in memory of President Grover Cleveland, erected out of popular contributions collected by the Cleveland Monument Association.

The endowments of the Graduate College include the Fellowship Fund of $300,000 given by William Cooper Procter of the Class of 1883 and the bequests under the will of Isaac C. Wyman of the Class of 1848.

The site of this group of buildings is on the crest of a slope in the western portion of the University Campus, two-thirds of a mile distant from Nassau Hall and on that portion of the revolutionary battlefield of Princeton where the final engagement of the battle occurred. The surrounding grounds have been laid out and planted under the direction of Mrs. Beatrix Farrand.

The body stone of all the buildings is the native bluish argillite with trim of Indiana limestone. The stone floors are of Vermont slate or terrazzo. Gray Germantown stone is used for the quoins of the Cleveland Tower, and buff

Kentucky sandstone for the interior of Procter Hall. The woodwork and furniture is entirely in oak, and the window casements are of stone with window frames of metal. The roof is grayish green Vermont slate.

The buildings have been designed and constructed in the perpendicular Gothic style by the architects Cram, Goodhue and Ferguson, of Boston, in accordance with the plan of Mr. Ralph Adams Cram. The group is formed around a central quadrangle, Thomson College, which measures about two hundred and fifty by two hundred feet, enclosing a court and lawn of about one hundred and seventy by one hundred and thirty feet, and containing suites for over one hundred students, besides the kitchen, service quarters, breakfast rooms, common room and reading room. The buildings are fireproof and are heated and lighted throughout by steam and electricity. All students' rooms are completely furnished, including window-curtains, bedding and bed linen, but not toilet linen. A single suite usually includes a study and a bedroom, with share of a toilet room. A double suite includes a study and two bedrooms, with share of toilet room. In some cases a single suite with exceptionally large study and bedroom is used as a double suite by double furnishing of the study and bedroom. Every study is provided with an electric reading lamp and nearly all the studies have open fireplaces.

Adjoining the main college gate at the southeastern corner of the quadrangle is the Cleveland Tower, forty feet square and one hundred and seventy-three feet high, containing in its base the vaulted memorial chamber of Indiana limestone, twenty-eight feet square and forty-eight feet high. At the eastern side of this lofty room is built a stone base backed and surmounted by a Gothic arch, where it is hoped a bronze statue of President Cleveland may be placed. The follow-

ing inscription is carved on the arch in severely plain capitals:

IN REMEMBRANCE OF
GROVER CLEVELAND
PRESIDENT OF THE UNITED STATES
PUBLIC OFFICE IS A PUBLIC TRUST

Above the memorial chamber is a large room which is reserved for relics of American history, and above this room is the open bell-chamber. A turret stair leads from the base to the top of the tower.

The southwestern corner of the quadrangle is completed by the Pyne Tower which contains the vestibule hall connecting the common room and Procter Hall, the suite for the Master in Residence, the guest rooms and, above this, a large suite in the fourth story. The vestibule hall, constructed entirely of Indiana limestone, has slender lierne vaulting. There is also a large tracery window and a fireplace with the motto: *In meditatione mea exardescet ignis.*

Projecting westward from the Pyne Tower is Procter Hall, the dining hall and chief public room of the Graduate College. The interior measures thirty-six by one hundred and eight feet. The floor is of Vermont slate, and the interior walls of buff Kentucky sandstone. The panelling and arching roof are in oak. A visitor's gallery with oak screen stands at the eastern end of the hall. At the western end there is a high oriel window on the south side and a large fireplace facing it on the north. Back of the high table is the brilliant memorial window in stained glass, designed and executed in the manner of the fourteenth century by Mr. and Mrs. William Willet. The window symbolizes Christian learning. In the lower part is a seated figure of the child Christ, teaching the assembled Doctors in the Temple. Below this is carved the inscription: *Nec vocemini magistri, quia magister vester unus est Christus.* The

upper portion contains richly draped figures of the Seven Liberal Arts, standing under an evening sky which deepens in the tracery above into the hues of a night sky with stars. Beneath this scene the following inscription is burnt in the glass: *Qui ad iustitiam erudiunt multos quasi stellae in perpetuas aeternitates.* The portraits hung in Procter Hall have been given by Mr. Thomas Shields Clarke of the class of 1882.

Wyman House, the residence of the Dean of the Graduate School, stands adjacent to Procter Hall on the southwest.

RESIDENCE IN THE GRADUATE COLLEGE

The object of the Graduate College buildings is to provide a suitable place of residence for graduate students, where they may have the full advantage of a common life in scholarly surroundings. In order that the privileges of these buildings may be generally available, the prices of residence have been fixed at a minimum cost, so that it will be possible to live there for less than the amount which would usually have to be paid in the town of Princeton. Certain rooms will be reserved particularly for the Jacobus and Procter Fellows, and the other Fellows are expected ordinarily to reside there. Rooms at minimum prices will be reserved for students who do not hold fellowships. The capacity of the building is 108 students.

All applications for admission to residence in the buildings of the Graduate College should be addressed to the Dean of the Graduate School, Princeton University, Princeton, New Jersey. Application blanks will be forwarded on request.

At the time the application blank is filled out each year and sent to the Dean of the Graduate School, a deposit of

ten dollars should accompany each application in the form of a cheque, New York draft or money order made payable to the *Treasurer of Princeton University.* This deposit will be credited against the student's bill for residence. In case the application is not granted, this fee of ten dollars will be refunded, but will not be returned in case the application is granted except as above stated.

Application for residence may be made at any time. So far as practicable, the rooms will be assigned in the order of application and in the order of preference indicated on the application blank. Subsequent changes of rooms will be allowed for good reasons, whenever possible. *Unless otherwise definitely arranged, the reservation of rooms is for one academic year of thirty-six weeks, including the Thanksgiving Recess and the Easter Recess, but not including the Christmas Vacation.*

The buildings will be open for occupancy by graduate students at the beginning of the next academic year, Tuesday, September 26, 1916. The service of meals will begin that evening. Baggage and other effects of graduate students admitted to residence may be sent to the buildings as early as Saturday, September 23, 1916.

In case of extended absence or withdrawal from residence in the Graduate College, requests for deductions are to be made to the Treasurer of the University. No deductions are made for temporary absence.

The prices charged for residence in the Graduate College include furnished rooms, light, heat, attendance and board, but not personal laundry. The rooms are divided into six groups, with the following present total charges to graduate students, assistants and instructors, for furnished rooms, board, light, heat and attendance for the academic year of thirty-six weeks:

Group I		$300.00
Group II		$330.00
Group III		$350.00
Group IV	Double	$370.00
	Single	$390.00
Group V		$420.00
Group VI		$480.00

The average weekly residential cost to the student thus ranges from $8.33 in Group I to $13.30 in Group VI. One person occupying a double suite alone is charged two-thirds of the price for two occupants. Arrangements for members of the Faculty, other than Instructors, who desire to reside in the Graduate College, are made at an advance over the graduate students' rates.

Graduate students rooming outside may be admitted to the table and other privileges of the Graduate College, except residence, at a charge of $230.00 for the academic year. Graduate students of the University who are not at the table nor resident in the buildings are invited to avail themselves of the other privileges of the Graduate College. Coupon books for occasional meals are furnished at a moderate cost for the use of the members of the Faculty, the graduate students, and their invited guests, as well as to the Trustees and alumni of the University.

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OFFICIAL REGISTER
OF
PRINCETON UNIVERSITY

VOLUME VIII JANUARY 29, 1917 NUMBER 7

Department of Biology

ANNOUNCEMENT FOR
1917-1918

Published by Princeton University
PRINCETON, NEW JERSEY

OFFICIAL REGISTER OF PRINCETON UNIVERSITY

[*Entered as second-class matter, December 23, 1909, at the Post Office at Princeton, N. J., under the Act of July 16, 1894.*]

Issued twice a month during December, January, February, March and April, and monthly in May and September.

These publications include:

The Catalogue of the University.

The Undergraduate Announcement.

The Reports of the President and the Treasurer.

The Descriptive Booklet.

The announcements of the several Departments, relating to the work of the next year. These are made as accurate as possible, but the right is reserved to make such changes in detail as circumstances may require.

The current number of any of these publications may be obtained by application to the Secretary of the University, Princeton, New Jersey.

PRINCETON UNIVERSITY

Department of Biology

UNDERGRADUATE AND GRADUATE COURSES,
MUSEUM, LABORATORIES, HIGHER DEGREES,
FELLOWSHIPS, THE GRADUATE COLLEGE

ANNOUNCEMENT FOR
1917-1918

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1917

CALENDAR

1917

Sept. 25, 3 P. M. Formal opening exercises.

Sept. 30. Last day for enrolment of graduate students at the office of the Dean of the Graduate School.

Oct. 11-13. First part of examination for the degree of Doctor of Philosophy.

Nov. 29. Thanksgiving Day.

Dec. 18, 1.30 P. M. Christmas vacation begins.

1918

Jan. 2, 10.30 A. M. Christmas vacation ends.

Feb. 13. Second term begins.

March 1. Last day for receiving applications for Fellowships and Graduate Scholarships.

March 27, 1.30 P. M.—April 2, 10.30 A. M. Spring recess.

May 9-11. First part of examination for the degree of Doctor of Philosophy.

June 6. Last day for receiving applications for the Master's degree.

June 16. Baccalaureate Sunday.

June 17. Commencement meeting of the Board of Trustees. Annual meetings of the Literary Societies. Class Day.

June 18. 171st Annual Commencement. Alumni Trustee election. Alumni luncheon.

FACULTY

JOHN GRIER HIBBEN, PH.D., LL.D., LITT.D., *President.*
ANDREW FLEMING WEST, PH.D., LL.D., HON. D.LITT. (Oxon.), *Dean of the Graduate School.*
HENRY BURCHARD FINE, PH.D., LL.D., *Dean of the Departments of Science.*
WILLIAM FRANCIS MAGIE, PH.D., LL.D., *Dean of the Faculty.*
HOWARD MCCLENAHAN, E.E., M.S., LL.D., *Dean of the College.*

WILLIAM BERRYMAN SCOTT, PH.D., LL.D., *Blair Professor of Geology.*
WALTER MEAD RANKIN, PH.D., *Professor of Biology, Secretary of the Department of Biology.*
CHARLES FREEMAN WILLIAMS MCCLURE, SC.D., *Class of 1877 Professor of Zoölogy.*
EDWIN GRANT CONKLIN, PH.D., SC.D., *Professor of Biology, Chairman of the Department of Biology.*
ULRIC DAHLGREN, A.B., M.S., *Professor of Biology.*
GEORGE HARRISON SHULL, PH.D., *Professor of Botany and Genetics.*
MARCUS STULTS FARR, SC.D., *Assistant Professor, Preceptor in Geology.*
EDMUND NEWTON HARVEY, PH.D., *Assistant Professor of Physiology.*
LEWIS ROBINSON CARY, PH.D., *Assistant Professor of Biology.*
STEWART PATON, M.D., *Lecturer in Neuro-Biology.*
ALFRED GOLDSBOROUGH MAYER, SC.D., *Lecturer in Zoölogy.*
CHARLES FREDERICK SILVESTER, *Assistant in Anatomy, Curator of the Museum of Zoölogy.*

RAYMOND HENRY FOGLER, B.S., *Assistant in Physiology and Biology.*
CHARLES LEO MACY, *Assistant in Genetics.*
BENJAMIN COE HELMICK, M.S., *Assistant in Genetics*
OLIVER JOHN IRISH, A.B., *Assistant in Biology.*

FELLOWS, 1916-1917

FRANKLIN PEARCE REAGAN, A.B., Indiana University 1913, PH.D., Princeton University, 1916, *Charlotte Elizabeth Procter Fellow.*

Carl Caskey Speidel, Ph.B., Lafayette College, 1914, *Francis Hinton Maule Fellow in Biology.*

Elmer Lentz Shaffer, B.S., Haverford College, 1915, *Class of 1887 Fellow in Biology.*

SCOPE OF THE COURSES IN BIOLOGY

The work of the Department of Biology falls into five subdivisions depending upon the subject matter; these are (1) General Biology, (2) Botany and Genetics, (3) Physiology, (4) Zoölogy and Animal Morphology, (5) Osteology and Palaeontology.

1. The first of these subdivisions includes courses in General Biology (201, 202), and Theories of Evolution (510).

2. The courses in Botany include the following: General Botany (303, 304), The Development of Plant Life (507), Systematic Botany of the Vascular Plants (508), Genetics (409, 410), Research in Genetics (521, 522).

3. The following courses are offered in Physiology: General Physiology (407, 408), Physical Chemistry of the Cell (513, 514), Preparation of Biological Compounds (519, 520).

4. The courses in Zoölogy and Animal Morphology are: Invertebrate Zoölogy (306), Comparative Anatomy of Vertebrates (401), Vertebrate Embryology (402), Histology (403), Advanced Histology (404), Cytology (501), Ontogenesis (502), Comparative Histology and Histogenesis (503), Histology of Kinetic and Nerve Tissues (504), Morphology of Organ Systems of Vertebrates (505), Special Problems of Vertebrate Anatomy (506), Morphology and Physiology of the Central Nervous System (515, 516), Normal and Experimental Embryology (517, 518).

5. The courses in Palaeontology and Osteology are: Comparative Osteology (305), Vertebrate Palaeontology (406), Vertebrate Palaeontology (511, 512).

ADMISSION AND REQUIREMENTS

All undergraduate work in the Department of Biology is elective, though some courses may be taken only in a prescribed sequence. An elementary course in general chemistry must precede or accompany the course in General Biology (201, 202). This course is open to sophomores, juniors and seniors in all courses; it is prerequisite to all other subjects in the Department except Botany 303, 304, which is open to juniors in all courses. All other undergraduate work in Biology is open to seniors in all courses, who have had the prescribed prerequisites.

Candidates for the degree of A.B. or Sc.B. who elect the Department of Biology for the major work of their junior and senior years are required to take two years of Chemistry and not less than two biological courses throughout the junior year and three throughout the senior year. Since there are more than this number of courses offered, some selection must be exercised, and it is desirable for a sophomore about to elect the Department to consult with some of its members as to a proper selection. It is advisable that these courses be taken in the following order:

FRESHMAN YEAR:—Chemistry 103, 104.
SOPHOMORE YEAR:—Physics 201, 202.
General Biology 201, 202.
JUNIOR YEAR:—Chemistry 303, 304.
Botany 303, 304.
Osteology 305.
Invertebrate Zoölogy 306.
SENIOR YEAR:—Anatomy and Embryology 401, 402.
Histology 403, 404.
Palaeontology 406.
Physiology 407, 408.
Genetics 409, 410.

Any undergraduate course may be taken by graduate students, but only the advanced courses which are marked with an asterisk in the following list may count as graduate work. The graduate courses are open only in properly qualified graduate students.

CHOICE OF COURSES WITH REFERENCE TO PARTICULAR AIMS

It is recognized that the purposes and needs of different students are various and the selection of courses in Biology should be made with reference to individual requirements. However, there are certain general purposes for which certain courses are particularly recommended.

1. *General Culture.* All courses offered by the Department of Biology are cultural in that they deal with the science in a philosophical rather than a technical manner, but among the courses some are more general and fundamental than others. The course in General Biology (201, 202) is the most general one given; it not only serves as an introduction to all other courses in the Department, but it presents a brief but broad survey of the principal methods and results of work in all fields of Biology and is especially suited to the needs of those who can take only one course in Biology, but who feel that some knowledge of life and its processes is an essential part of a liberal education. To those who can take additional courses, any or all of the other undergraduate courses in Biology are recommended as of cultural value.

2. *Preparation for Medicine and for other Biological Professions.* No "premedical" courses are offered, but the more advanced courses in Biology lay broad foundations for the study of medicine, sanitation, hygiene, physical culture, scientific agriculture, forestry or other biological professions.

Biology is now required for admission to the best medical

schools. In addition to this requirement, which may be met by courses 201, 202, it is desirable that prospective students of medicine should obtain a broader acquaintance with biology as a whole than is possible in a medical school, where work is in the main highly specialized and technical.

3. *Teaching and Research.* The graduate courses in Biology are intended primarily for those who propose to engage in teaching or research and they may lead to the degrees of A.M. or Ph.D. In general the undergraduate courses are prerequisite to the graduate courses. Candidates for higher degrees are expected to show a broad general knowledge of biology as a whole, and a comprehensive and detailed knowledge of some one main division of it, such as Botany, Zoölogy, Anatomy or Physiology.

UNDERGRADUATE COURSES

201, 202. General Biology. Lectures, laboratory work, and recitations. An introduction to the fundamental properties of living things, their functions, structures, classification, habits, life-histories, and evolution. Selected forms are studied in the laboratory as illustrating the chief principles and generalizations of biology. Sophomore elective for students in all courses, both terms, 3 hours a week. Must be preceded or accompanied by General Chemistry 103, 104, or its equivalent. Prerequisite to the subsequent courses in Biology, except Botany 303, 304. Professors Conklin and Cary, Mr. Fogler, and Mr. Irish.

303, 304. Botany. Practical work in the field and laboratory, lectures and recitations. An introduction to the general principles of plant life. Besides the structure and functions of plants, their taxonomy and their relation to their environment will be studied, use being made of the facilities offered by the grounds of the

University. Junior course, both terms, 3 hours a week. Professor Rankin.

305. Comparative Osteology. Ontogeny and comparative structure of the skeletons of the different classes of vertebrates. Exercises in descriptive work. Each student must prepare a thesis on a skeleton especially assigned for his study. Junior course, first term, 3 hours a week. Must be preceded or accompanied by General Biology 201, 202. Professor Farr.

306. Invertebrate Zoology. Lectures and laboratory work on selected phyla of invertebrates. Junior course, second term, 3 hours a week. Prerequisite course, General Biology 201. Professor Cary.

*401. Comparative Anatomy of Vertebrates. Lecture and laboratory course. Lectures on the comparative anatomy of the organ systems of vertebrates, and dissection of the dog-fish and a mammal. Senior course, first term, 3 hours a week. Prerequisite courses: Sophomore and junior courses in Biology. Professor McClure and Mr. Silvester.

*402. Vertebrate Embryology. Lecture and laboratory course. A comparative study of the development of vertebrates. Senior course, second term, 3 hours a week. Prerequisite course: Comparative Anatomy 401. Professor McClure and Mr. Silvester.

*403. Histology. A study of protoplasm, cells, and tissues as they underlie animal and vegetable life; the histology of the fundamental tissues of support, energy production, sensation and conduction. Senior course, first term, 3 hours a week. Prerequisite course: Biology 201, 202. Professor Dahlgren.

*404. Advanced Histology. The comparative Histology of the tissues of reproduction, assimilation, circulation,

* Also listed as a graduate course.

excretion and secretion. Practice in microscopical technic. Thesis. Senior course, second term, 3 hours a week. Prerequisite course: Histology 403. Professor Dahlgren.

*406. Vertebrate Palaeontology. Lectures and laboratory work on fossil vertebrates. Senior course, second term, 3 hours a week. Prerequisite courses: Biology 201, 202, and Osteology 305. Professors Scott and Farr.

*407, *408. General Physiology. Lectures and laboratory work. An introduction to the phenomena exhibited by living matter. The substances of which organisms are composed will be studied and their rôle in the functioning of the cell discussed. The general physiology of muscle and nerve tissue, of the digestive tract (including absorption, nutrition, secretion and excretion) and of the circulatory system (including respiration) will then be taken up, followed by an account of the coordinate activities of the nervous system, reflexes, tropisms, and the phenomena of reproduction, growth and regeneration. Senior course, both terms, 3 hours a week. Prerequisite course: Biology 201, 202. Professor Harvey, assisted by Mr. Fogler.

*409, 410. Genetics. Lectures, recitations, and laboratory work. The development, variation, modification and inheritance of morphological and physiological characteristics of plants and animals, and the application of the principles of genetics to the improvement of plants, animals, and man. Laboratory work will consist largely of actual research on simple problems calculated to give facility in the collection and analysis of data, and an insight into the principles involved

* Also listed as a graduate course.

in development, variation and heredity. Well written theses presenting the results of the laboratory work will be expected of each student. Senior course, both terms, 3 hours a week. Prerequisite course: Biology 201, 202. Professor Shull and Mr. Helmick.

FINAL SPECIAL HONORS

Juniors and seniors in the Department of Biology may become candidates for Final Special Honors, in accordance with the general regulations for Final Special Honors.

1. Candidates for Final Special Honors in Biology must take the course in General Biology (201, 202) either in their sophomore or junior year and must supplement this by Advanced General Biology 301.

2. In junior year they must take:

Advanced General Biology (301); supplementary to General Biology 201, 202; 3 hours a week, with reading and laboratory work, 1st term.

Invertebrate Zoölogy (306); with 3 hours a week supplementary reading and laboratory work, 2nd term.

Botany (303, 304); with 3 hours a week supplementary reading and laboratory work, both terms.

3. In senior year they must take two of the following courses:

Comparative Anatomy (401); with 3 hours a week supplementary reading and laboratory work, 1st term. Vertebrate Embryology (402); with 3 hours a week supplementary reading and laboratory work, 2nd term.

General Physiology (407, 408); with 3 hours a week supplementary reading and laboratory work, both terms.

Histology (403, 404); with 3 hours a week supplementary reading and laboratory work, both terms.
Genetics (409, 410); with 3 hours a week supplementary reading and laboratory work, both terms.

4. In place of the regular term examinations at the end of senior year, candidates for Final Special Honors in Biology shall take comprehensive examinations covering the Honors work of both junior and senior years.
5. In addition to the supplementary work in connection with each of the courses named, candidates for Final Special Honors in Biology are expected to read the following works before the close of senior year and to pass an oral examination on them:
Beddard: *Geographical Distribution*
Darwin: *Origin of Species*
Ganong: *The Living Plant*
Huxley: *Man's Place in Nature*
Kellogg: *Darwinism Today.*
Locy: *Biology and its Makers*
Mendel: *Experiments in Plant Hybridization*
Wallace: *Malay Archipelago*
Walter: *Genetics*
Weismann: *The Germ Plasm*

GRADUATE COURSES

While such of the undergraduate courses as are marked with an asterisk in the preceding pages may be taken by graduates, the courses outlined below are intended only for graduates. Any of the following courses will be given if applied for by any duly qualified graduate student.

501. Cytology. Lectures, laboratory and research work on protoplasm, the structures and functions of cells, nuclear and cell division, origin and maturation of the germ cells. First term, 3 hours a week. Alter-

nates with course 518. [1917-1918.] Professor Conklin.

502. Ontogenesis. Lectures, laboratory and research work on the fertilization, cleavage and promorphology of the egg; phenomena of differentiation; problems of experimental embryology; the cellular basis of heredity and evolution. Second term, 3 hours a week. Alternates with course 518. [1917-1918.] Professor Conklin.

503. Comparative Histology and Histogenesis. Studies of supporting, nutritive, excretory, respiratory and several other groups of tissues, including their origin and development, repair, regeneration and metamorphosis. Lectures, laboratory and research work. First term, 3 hours a week. Professor Dahlgren.

504. Histology of the Kinetic and Nerve Tissues. Comparative studies of the organs and tissues which produce light, heat, motion, and electricity; the tissues of nervous sensation, communication, and stimulation; the organization of nerve tissues in several animal forms. Lectures, laboratory and research work. Second term, 3 hours a week. Professor Dahlgren.

505. Morphology of the Organ Systems of Vertebrates. Conferences, laboratory, and research work on the comparative anatomy and development of the organ systems of vertebrates. About 3,000 anatomical preparations and an embryological collection of about 1,200 series are at present available for reference and study in connection with this course. First term, 3 hours a week. Professor McClure.

506. Special Problems of Vertebrate Anatomy. Conferences, laboratory, and research work. This course is designed to place the student in a position to comprehend the main problems of vertebrate morphology

and completes the study of the comparative anatomy and development of the organ systems of the anamnia and amniota. Second term, 3 hours a week. Professor McClure.

507. The Development of Plant Life. Studies in the structure, life-history, and taxonomy of various groups of plants. First term, 3 hours a week. Professor Rankin.

508. Systematic Botany of the Vascular Plants. Structure as related to description and classification. Exercises in plant analysis, description and classification. The characters of the larger families of Angiosperms. Second term, 3 hours a week. Professor Rankin.

510. Theories of Evolution. A history of the doctrine of evolution, with discussion of the theories which have been proposed to explain the modes and factors of development. Second term, 3 hours a week. Professor Scott.

511, 512. (Geology 511, 512.) Vertebrate Palaeontology. Lectures and laboratory work on the morphology and evolution of fossil vertebrates. Both terms, 3 or more hours a week. Professors Scott and Farr.

513, 514. Physical Chemistry of the Cell. An application of the principles of physical chemistry to physiological problems. The rôle of diffusion, osmotic pressure, electrolytic dissociation, reaction velocity, catalytic action and surface tension in organisms, the properties of colloids, the effect of salt on cells, and the permeability of cells and tissues will be studied in considerable detail. Based on Philip's *Physical Chemistry,* and Hoeber's *Physikalische Chemie der Zelle und Gewebe,* (third edition). Both terms, 3 hours a week. Professor Harvey.

515, 516. Morphology and Physiology of the Central Nervous System. A series of conferences with graduate

students, together with assignments of problems and direction of research work in the field of Neuro-Biology. Both terms, number of hours indefinite. Dr. Paton.

517, 518. Normal and Experimental Embryology. A study of the principles of development and of embryonic differentiation. The work is both observational and experimental and includes a study of normal life-histories as well as experimental studies on the factors of differentiation and development. Important books and original publications dealing with the subject are assigned for study. Both terms, 3 hours a week. Alternates with courses 501, 502. [1918-1919.] Professor Conklin.

519, 520. Preparation of Biological Compounds. The isolation and purification of typical proteins, lipoids, carbohydrates, and extractives from plant and animal tissues. Open to men having some experience in Biological Chemistry. Matthews: *Physiological Chemistry*. Both terms, 3 or more hours a week. Professor Harvey.

521, 522. Research in Genetics. The investigation of problems in variation and heredity of plants and animals, with assigned readings and conferences. Open to men fully qualified by previous training. Both terms, 3 or more hours a week and extending through the summer season. Professor Shull.

NON-DEPARTMENTAL COURSE

*407. History of Modern Science. This is a non-technical course in the development of scientific thought from the time of Copernicus and Galileo to the present. The course runs parallel to the courses in the history

* Also listed as a graduate course.

of philosophy and of literature and of political and social thought. The character and the influence of the great discoveries in Astronomy, Mechanics, Physics, Chemistry and Biology will be studied by means of lectures and reading. The general purpose of the course is to give both the technical and the non-technical student information and training in the meaning and historical results of scientific investigation in different fields. Senior course, first term, 3 hours a week. Professor Spaulding.

PUBLIC LECTURES

The Study of Human Activities in relation to Educational and Social Problems. Occasional lectures open to all members of the University. Dr. Paton.

Occasional public lectures upon oceanographic and physiological subjects, and also lectures in connection with zoölogical courses upon the embryology, anatomy, physiology, and relationships of coelenterates. Dr. Mayer.

BIOLOGICAL SEMINARY AND JOURNAL CLUB

An organization of the instructors and graduate students of the department, which meets weekly throughout the academic year for the presentation of the results of original work, reports upon assigned topics, and reviews of recent biological literature.

BUILDINGS, FACILITIES, ETC.

The Biological Department is housed in the east half of Guyot Hall, which was erected in 1909 at a cost of about $425,000. This building is situated at the southeast corner of the campus on the southerly slope below the Palmer Physical Laboratory, and beyond it fields, woods, and brooks

extend down to Lake Carnegie, thus affording unrivaled opportunities for biological gardens and vivaria.

The inside dimensions of the building are 288 feet long and 56 feet wide, with a south extension 63 feet long by 35 feet wide. Its central section has a basement and four stories, and the ends and extension have three and two stories respectively. With a cubical content of about 1,250-000 cubic feet it has a total serviceable floor space of 85,146 square feet.

The Departments of Biology and Geology occupy approximately equal portions of the building, Biology having the eastern and Geology the western end, and certain rooms are used in common; i.e., the museum, the large lecture room, the general library and reading room. The museum occupies the entire first story, having a height of 18 feet, and, with its gallery along the south side of the central section, affords about 19,300 square feet of floor space. The lecture room, central in the basement, with 210 seats, has brilliant natural and artificial illumination, and is provided with all appurtenances needed for conducting lecture courses and meetings of scientific societies. The library, centrally located on the second floor, has a reading room space of 25×25 feet and lateral stacks holding the working libraries of the biological and geological sciences, with capacity for about twenty-five thousand volumes.

The laboratories are arranged in ten separate suites, each suite as a rule accommodating a distinct subject, and five such suites are in each department. In addition there are rooms for graduate students and for investigators, seminary rooms, machine shops, curatorial, preparation, and store rooms, and finely equipped quarters for photographic work. Special rooms are designed for seismographical and meteorological stations. Excluding several rooms used for janitorial and other purposes, 103 rooms are devoted to the work of the scientific departments.

VIVARIA

The study of living plants and animals is a most important part of Biology, and unusual facilities are here offered for such study. In addition to the natural advantages of the situation, afforded by the presence, in the immediate vicinity of the Laboratory, of fields, woods, brooks, Lake Carnegie and the canal, especial preparations have been made for keeping under experimental and observational conditions a considerable variety of animals and plants. The Vivarium is a separate building with glass roof and large concrete aquaria; the latter have an aggregate area of nearly four hundred square feet and a capacity of about ten thousand gallons, one half of which is devoted to sea-water, and the other half to fresh-water. In addition there are rooms with suitable cages for keeping insects, amphibians, reptiles, birds and mammals; also private research rooms, photographic rooms and pump rooms. Adjoining the building are flying cages for birds, runways for mammals, and glass houses for plants. Near the Vivarium a biological pond has been formed by damming up a brook, and various cages and retreats will be established as they are needed along the brook and in the woods where many animals may be kept and studied under natural conditions.

MUSEUMS AND COLLECTIONS

The Zoölogical Collections are especially rich in osteological and ornithological material. The former includes a large number of mounted and disarticulated skeletons of fishes, reptiles, birds and mammals. The collections of mounted and unmounted bird skins are especially large, including some sixteen thousand individuals, representing very completely the avifauna of New Jersey, and in part that of North America, Europe, Indo-Asia, Australia, and South America. These collections are supplemented by some four

thousand sets of eggs, most of them in nests. The collection of Invertebrata includes a complete series of specimens prepared by the Zoölogical Station at Naples, as well as a large number of corals and shells of mollusks.

The Morphological Museum contains about three thousand preparations, which consist of dissections and corrosions, illustrating the comparative anatomy of vertebrates.

The Histological Collection is located on the second floor of the building and consists of some thirty thousand mounted microscopical specimens illustrating the various forms of tissues of many different animals; some five thousand specimens are stored in paraffin blocks.

The Botanical Collections are arranged on the third floor and include, besides certain illustrative specimens, models and charts, a Herbarium of mounted plants, classified according to Engler and Prantl's *Pflanzenfamilien*. The Herbarium includes a local collection, representing the New Jersey flora, of four thousand sheets; some forty thousand sheets of plants from different sections of the United States, from South America, Europe, and Asia; and ten thousand sheets of mosses, recently acquired from Dr. Per Dusen of Sweden.

The Palaeontological Collections are particularly rich and valuable and include large series of Tertiary fossils from the western part of the United States, and from Patagonia.

THE BIOLOGICAL LABORATORIES

The Biological Laboratories are located in the east half of Guyot Hall and comprise, in addition to the museums, the library, laboratories, research rooms, and seminary rooms for Zoölogy, Physiology and Botany.

The Zoölogical and Anatomical Laboratories include five class rooms, equipped as laboratory-lecture rooms, seven

private research rooms, two preparation rooms, a chemical room, two photographic rooms, an artist's room and six store rooms.

The Physiological Laboratories comprise one large laboratory-lecture room, two smaller laboratories, three private research rooms, a photographic room and a shop. These rooms closely adjoin the animal rooms in the sub-basement and Vivarium.

The Botanical Laboratory includes two laboratory-lecture rooms, four private rooms and the herbarium room. A glass house and vivarium afford at all seasons a considerable variety of land, fresh-water, and marine plants for study. A greenhouse 22×100 feet, with headhouse 15×24 feet, has been erected and fully equipped for experimental work in genetics, and about fourteen acres of level land to the south of Guyot Hall have been set apart and especially prepared for the growing of pedigree-cultures.

The Palaeontological Laboratories are part of the Geological equipment and are found in the west half of the building.

LIBRARY

The Biological Library consists of about fourteen thousand volumes. It contains sets of about ninety of the principal biological periodicals, as well as standard reference books and monographs. Through the generosity of Mr. Charles W. McAlpin, of the class of 1888, several hundred volumes are added to it each year.

PUBLICATIONS

Reprints of scientific articles published by members of the Biological Department are collected and issued in volumes under the general title, *"Contributions from the Biological Laboratories in Princeton University."*

ADMISSION TO THE GRADUATE SCHOOL

The affairs of the Graduate School are administered by a committee of the University Faculty known as the Faculty Committee on the Graduate School. The Dean of the Graduate School is Chairman of this committee. All inquiries should be addressed to Professor West, Dean of the Graduate School.

Applicants who possess a Bachelor's degree from Princeton University, or from other institutions maintaining a similar standard in distinctively liberal studies for the Bachelor's degree, may be admitted to the Graduate School subject to the following regulations:

1. Admission on diploma to the Graduate School is granted to Bachelors of Princeton University whose standing for the undergraduate course is within the first three General Groups. A Bachelor of lower standing may not be admitted unless his average standing in undergraduate studies in the department of his proposed graduate work is higher than the Third Group.

2. The equivalent of this standard is expected of applicants holding the Bachelor's diploma from other colleges and universities.

3. In every case the further question of eligibility for a higher degree will be determined by the academic record of the applicant and his ascertained ability to pursue graduate studies.

No officer of instruction in the University, except an assistant or instructor on half-time appointment, or an instructor who has fulfilled the requirements as to residence prior to his appointment as instructor, may be a candidate for any degree. The minimum residence requirement for the higher degrees will ordinarily be increased at the discretion of the Committee on the Graduate School, in the case of instructors or assistants on half-time appointment.

All graduate students, whether graduates of Princeton or of another institution, are required to apply for admission at the office of the Dean of the Graduate School before October first of each year, and those who present themselves for the first time must submit to the Dean their diplomas and such other credentials as may be required.

Immediately after admission every graduate student, including graduate students of the previous year, shall register and report his courses at the office of the Dean of the Graduate School.

FEES

Graduates of universities other than Princeton are required to pay to the Treasurer a matriculation fee of five dollars. A diploma fee of five dollars is charged every graduate student coming up for a higher degree. Every graduate student on full time, except holders of Jacobus or Procter Fellowships, is required to pay an annual tuition fee of one hundred dollars. Every graduate student on part time, except part-time assistants in Princeton University and students in Princeton Theological Seminary, is required to pay an annual tuition fee of forty dollars.

In accordance with a reciprocal arrangement between the University and Princeton Theological Seminary, duly qualified students of either institution are admitted without charge for tuition to the privileges of the other.

No charge for laboratory fees is made to graduate students, but if any department controlling a laboratory desires to charge for expenses and certifies its desire to the Treasurer, a deposit, the amount of which is to be fixed by the department concerned, will be required to cover in whole or in part the expense incurred for supplies (subject to rebate in case the actual expense is less than the amount of the deposit).

DEGREES

The following degrees are given for graduate study: Master of Arts and Doctor of Philosophy.

MASTER OF ARTS

The degree of Master of Arts may be conferred only upon those who hold a Bachelor's degree in the liberal arts and sciences from this or another approved college who shall also have devoted at least one year exclusively to resident graduate study in the University under the care of the Faculty, passing examinations upon the studies pursued; or shall have taken graduate courses in the University involving at least three hours a week each term for four terms and passed satisfactory examinations upon these courses, and on such extra reading as may be assigned. Every candidate for the Master's degree in one year is expected to take throughout the year at least three graduate courses, unless another arrangement is permitted by the Faculty Committee on the Graduate School. These courses shall be such as to form a consistent and well coördinated body of studies, and shall be subject to the approval of the Faculty Committee on the Graduate School.

Students of Princeton Theological Seminary who are enrolled in the Graduate School and maintain an average standing of not lower than Second Group in the regular course of Princeton Theological Seminary may proceed to the Master's degree if they satisfy the requirements of the University for the degree.

DOCTOR OF PHILOSOPHY

Subject to the regulations hereinafter stated, the degree of Doctor of Philosophy may be conferred upon any bachelor of Princeton University, or of another approved institution, provided he has spent at least two years exclusively

in study for the degree. It should be clearly understood that two years is the minimum period required and that in all but the rarest cases three years will be found necessary. One year must be spent in residence at Princeton.

REGULATIONS

Subjects of Study. An applicant for the degree of Doctor of Philosophy chooses one of the following subjects of study:

Philosophy	English
History	Mathematics
Politics	Astronomy
Economics	Physics
Art and Archaeology	Chemistry
Classics	Biology
Romanic Languages	Geology
Germanic Languages	

The examination for the degree of Doctor of Philosophy consists of two parts, known as the First Part and the Second Part.

Before offering himself for the First Part of the examination for the Doctor's degree the applicant is expected to have acquired a broad, general knowledge of the subject which he has chosen and a comprehensive and detailed knowledge of some one main division of it. In certain cases, however, the applicant may, on the recommendation of the department in which his subject lies and with the approval of the Faculty Committee on the Graduate School, substitute for a main division of his subject a like division of a germane subject; or he may be required to take additional work outside his subject.

Applicants for the Doctor's degree are also required to take at some time during their period of graduate study a

series of public lectures on the general trend of philosophical and scientific thought, to be given, with assigned collateral reading, by a member of the Department of Philosophy.

The First Part of the Examination. The First Part of the examination for the Doctor's degree is designed to test the student's mastery of his subject of study and is to be held not earlier than toward the close of the second year of graduate study. This examination may be written or oral, or both, at the discretion of the department which gives the examination.

No applicant for the degree of Doctor of Philosophy is to be enrolled as a candidate until he has satisfactorily sustained the First Part of the examination for the Doctor's degree as described above, and has shown that he is able to use French and German as instruments of research.

In case the First Part of the examination for the Doctor's degree is not sustained, the applicant may be allowed by permission of the Committee on the Graduate School to present himself for a second trial after the lapse of at least one academic term. If this second trial is unsatisfactory, no further examination will be allowed.

A student who has sustained the First Part of the examination for the Doctor's degree is entitled thereby to be recommended for the degree of Master of Arts.

The Thesis. After the applicant has sustained the First Part of the examination and has been enrolled as a candidate for the Doctor's degree he shall present to the department in which his work chiefly lies a thesis on some topic in the special field of his study.

The Second Part of the Examination. When the thesis has been accepted by the department, as giving evidence of high attainment and the power of independent research, the candidate proceeds to the Second Part of the examination for the Doctor's degree. This is a public oral examination

in the field of the thesis and the more comprehensive aspects of the subject of study, and may not be divided.

Granting of the Degree. The Doctor's degree will be granted only after the First Part of the examination for the Doctor's degree has been sustained, the thesis accepted, the Second Part of the examination for the Doctor's degree sustained, and arrangements for publication of the thesis completed by the candidate and approved by the Committee on the Graduate School.

One hundred copies of the printed thesis must be deposited in the University Library.

UNIVERSITY FELLOWSHIPS

These fellowships were founded by subscription and endowment and are intended to encourage advanced study and promote original research in the several departments to which they are assigned. They are distinguished from the College fellowships by being open to the graduates of any American college, while the appointments are made, not by competitive examination, but by a comparison of the records presented by the applicants as to their previous collegiate standing, capacity, and character.

The University fellowships are subject to the following regulations:

1. A Fellow must devote himself to study under the direction of the department in which the fellowship is provided. But any Fellow resident in Princeton may be called upon occasionally to give instruction in his department.

2. A Fellow is not ordinarily permitted to give private tuition.

3. The fellowships are to be held for one year, but in cases of special merit they may be continued for a longer period by recommendation of the department and sanction of the Faculty.

4. The candidates shall be graduates possessing a satisfactory Bachelor's diploma in liberal studies from an accredited American college. An application should be accompanied with evidence of the qualifications of the applicant to pursue an independent course of study and investigation in the department concerned.

5. Appointment shall be made by the Faculty upon recommendation of the professors in the department interested and of the Faculty Committee on the Graduate School, and shall be announced at Commencement.

6. All requests for fellowship or scholarship application blanks should be addressed to the Dean of the Graduate School and all applications should be in the hands of the Dean of the Graduate School on or before March 1, the appointees to hold their positions for a year from the following September. Applications received later than March 1 may be considered in special cases, and to fill vacancies.

ADVANCED UNIVERSITY FELLOWSHIPS

The University Fellowships are divided into two classes, the advanced and the ordinary.

The advanced fellowships include the Jacobus Fellowship and the ten Procter Fellowships. They have an annual stipend of one thousand dollars each, exempt from charge for tuition, and are assigned only to graduate students of at least one year's standing who have given evidence of unusual ability in their graduate work and of capacity to engage successfully in research.

PORTER OGDEN JACOBUS FELLOWSHIP

Established in 1905 by the generosity of Mrs. Clara Cooley Jacobus. This fellowship will be conferred upon that regularly enrolled student of the Graduate School who, in the judgment of the University Faculty, shall have

evinced the highest scholarly excellence in his graduate work during the year. The appointee to this fellowship receives the income from an endowment of $25,000 and is expected to devote himself exclusively to study under the direction of the Faculty.

THE CHARLOTTE ELIZABETH PROCTER FELLOWSHIPS

These fellowships are established on an endowment of three hundred thousand ($300,000) dollars, given in memory of Charlotte Elizabeth Procter by her son. The terms of the fellowships are as follows:

1. The fellowships shall be known as The Charlotte Elizabeth Procter Fellowships, and the holders thereof shall be exempt from tuition fees.

2. The fellowships are open only to unmarried men who are graduates of not more than six years' standing and who hold the Bachelor's degree in distinctively liberal studies from Princeton University or from some other institution maintaining a similar standard for the Bachelor's degree.

3. Appointment is to be made by vote of the University Faculty on nomination by the Dean of the Graduate School after consultation with the full professors in the department interested.

4. The tenure of each fellowship is one academic year, subject to re-appointment for not more than two years longer, except on evidence of extraordinary ability and upon unanimous vote of the University Faculty.

5. The fellowships are not to be allocated to separate departments but are open to all the departments conducting graduate work in the liberal arts and sciences.

6. Every Fellow appointed on this Foundation shall reside in the buildings of the Graduate College, unless dispensed therefrom by the Dean of the Graduate School, and shall devote himself to advanced study to the exclusion of

tutoring, teaching, lecturing or any other occupation or employment.

7. In case the conduct or work of any Fellow is unsatisfactory, the tenure of his fellowship may be terminated by the University Faculty.

8. The stipend of each fellowship shall be one thousand ($1,000.00) dollars annually, and no fellowship may be divided.

9. The income of the Foundation is to be applied to maintaining as many fellowships, each yielding one thousand ($1,000.00) dollars annually, as eighty per cent of the income will warrant. All income in excess of eighty per cent shall be applied first, to maintaining the principal of the Foundation, and then to re-investment for the purpose of increasing the stipend of the fellowships in amounts of one hundred ($100.00) dollars each, as rapidly as eighty per cent of such re-investment will permit.

PROVIDED, HOWEVER, that whenever the stipend of such fellowships amounts to fifteen hundred ($1,500.00) dollars each per year, thereafter no further increase in the stipend shall be made, but additional fellowships of fifteen hundred ($1,500.00) dollars shall be founded as rapidly as said eighty per cent of such re-investment will allow. All excess of income remaining at the end of each fiscal year is to be applied to the increase of the capital fund.

ORDINARY UNIVERSITY FELLOWSHIPS

The ordinary fellowships regularly have a stipend of six hundred dollars on first appointment, and of seven hundred dollars on re-appointment, subject to the charge of one hundred dollars for tuition. The number of these fellowships is approximately thirty-five and varies slightly from year to year. Sixteen of them are wholly or partly endowed and the funds needed to supplement the partly endowed

fellowships and to add others are derived from University appropriations. Of the endowed fellowships of special interest to students in the Department of Biology are those described below:

CLASS OF 1877 UNIVERSITY FELLOWSHIP IN BIOLOGY

This fellowship has an income of $400 per annum.

FRANCIS HINTON MAULE BIOLOGICAL FELLOWSHIP

This fellowship was founded in 1901 by Mr. and Mrs. Francis I. Maule as a memorial of their son, Francis Hinton Maule, who was a student in the University during the years 1895-98. It is conferred by appointment of the faculty and has an endowment of $10,000.

Students in the Department of Biology are also eligible to the following fellowships:

GORDON MACDONALD FELLOWSHIP

This fellowship, at present unassigned to any department, was established in 1908 by Mr. James Speyer as a memorial to his friend and partner, Gordon Macdonald. The endowment yields about $500 annual income.

CLASS OF 1883 UNIVERSITY FELLOWSHIPS

In June, 1910, the Class of 1883 contributed the sum of $30,000 to establish two University Fellowships with an income of not less than $600 each; the two fellowships to be awarded by preference in the Departments of Politics, Physics, Chemistry, Biology, or Geology.

GRADUATE SCHOLARSHIPS

A number of graduate scholarships yielding respectively two hundred and fifty dollars and one hundred dollars each,

subject to the charge of one hundred dollars for tuition, are maintained by university appropriation. They are awarded by the Faculty, on the basis of scholarship, upon the recommendation of the Professors in the several departments, and of the Faculty Committee on the Graduate School.

THEODORE CUYLER GRADUATE SCHOLARSHIP

This scholarship, open to students in any department, was founded by the late C. C. Cuyler, of the Class of 1879, and was constituted as a graduate scholarship in 1909. It pays the holder $300, less the charge of one hundred dollars for tuition.

THE GRADUATE COLLEGE BUILDINGS

The buildings of the Graduate College were completed in September, 1913. This group of buildings consists of Thomson College, the gift of the late Mrs. J. R. Thomson Swann; Procter Hall, the gift of William Cooper Procter of the Class of 1883 in memory of his parents; Pyne Tower, the gift of M. Taylor Pyne of the Class of 1877; Wyman House, contributed by the Estate of Isaac C. Wyman; and the Cleveland Memorial Tower in memory of President Grover Cleveland, erected out of popular contributions collected by the Cleveland Monument Association.

The endowments of the Graduate College include the Fellowship Fund of $300,000 given by William Cooper Procter of the Class of 1883 and the bequests under the will of Isaac C. Wyman of the Class of 1848.

The site of this group of buildings is on the crest of a slope in the western portion of the University Campus, two-thirds of a mile distant from Nassau Hall and on that portion of the revolutionary battlefield of Princeton where the final engagement of the battle occurred. The surrounding grounds have been laid out and planted under the direction of Beatrix Farrand.

The body stone of all the buildings is the native bluish argillite with trim of Indiana limestone. The stone floors are of Vermont slate or terrazzo. Gray Germantown stone is used for the quoins of the Cleveland Tower.

The buildings have been designed and constructed in the perpendicular Gothic style by the architects Cram, Goodhue and Ferguson of Boston, in accordance with the plan of Mr. Ralph Adams Cram. The group is formed around a central quadrangle, Thomson College, which measures about two hundred and fifty by two hundred feet, enclosing a court and lawn of about one hundred and seventy by one hundred and thirty feet, and containing suites for over one hundred students, besides the kitchen, service quarters, breakfast rooms, common room and reading room.

Adjoining the main college gate at the southeastern corner of the quadrangle is the Cleveland Tower, forty feet square and one hundred and seventy-three feet high, containing in its base the vaulted memorial chamber of Indiana limestone, twenty-eight feet square and forty-eight feet high. At the eastern side of this lofty room is built a stone base backed and surmounted by a Gothic arch, where it is hoped a bronze statute of President Cleveland may be placed. The following inscription is carved on the arch in plain capitals:

IN REMEMBRANCE OF
GROVER CLEVELAND
PRESIDENT OF THE UNITED STATES
PUBLIC OFFICE IS A PUBLIC TRUST

The tower was erected in 1912 from public subscriptions of the people of the United States.

The southwestern corner of the quadrangle is completed by the Pyne Tower which contains the vestibule hall connecting the common room and Procter Hall, the suite for the Master in Residence, the guest rooms, and, above this, a large suite in the fourth story.

Projecting westward from the Pyne Tower is Procter Hall, the dining hall and chief public room of the Graduate College. The interior measures thirty-six by one hundred and eight feet. The floor is of Vermont slate, and the interior walls of buff Kentucky sandstone. The panelling and arching roof are in oak. A visitor's gallery with oak screen stands at the eastern end of the hall. The organ in this gallery, the gift of Mr. Henry C. Frick, consists of pedal, great, swell and choir organs, and an antiphonal organ placed in another part of the hall. The oak case was designed under direction of Mr. Ralph Adams Cram. At the western end there is a high oriel window on the south side and a large fireplace facing it on the north. Back of the high table is the brilliant memorial window in stained glass, designed and executed in the manner of the fourteenth century by Mr. and Mrs. William Willet. The portraits hung in Procter Hall have been given by Mr. Thomas Shields Clarke, of the class of 1882.

Wyman House, the residence of the Dean of the Graduate School, stands adjacent to Procter Hall on the southwest.

RESIDENCE IN THE GRADUATE COLLEGE

The object of the Graduate College buildings is to provide a suitable place of residence for graduate students, where they may have the full advantage of a common life in scholarly surroundings. In order that the privileges of these buildings may be generally available, the prices of residence have been fixed at a minimum cost, so that it will be possible to live there for less than the amount which would usually have to be paid in the village of Princeton. Certain rooms will be reserved particularly for the Jacobus and Procter Fellows, and the other Fellows are expected ordinarily to reside there. Rooms at minimum prices will be reserved for students who do not hold fellowships. The capacity of the building is 108 students.

All applications for admission to residence in the buildings of the Graduate College should be addressed to the Dean of the Graduate School, Princeton University, Princeton, New Jersey. Application blanks will be forwarded on request.

At the time the application blank is filled out each year and sent to the Dean of the Graduate School, a deposit of ten dollars should accompany each application in the form of a cheque, New York draft or money order made payable to the *Treasurer of Princeton University.* This deposit will be credited against the student's bill for residence. In case the application is not granted, this fee of ten dollars will be refunded, but will not be returned in case the application is granted, except as above stated.

Application for residence may be made at any time. So far as practicable, the rooms will be assigned in the order of application and in the order of preference indicated on the application blank. Subsequent changes of rooms will be allowed for good reasons, whenever possible. *Unless otherwise definitely arranged, the reservation of rooms is for one academic year of thirty-six weeks, including the Thanksgiving Recess and the Easter Recess, but not including the Christmas Vacation.*

The buildings will be open for occupancy by graduate students at the beginning of the next academic year, Tuesday, September 25, 1917. The service of meals will begin that evening. Baggage and other effects of graduate students admitted to residence may be sent to the buildings as early as Saturday, September 22, 1917.

In case of extended absence or withdrawal from residence in the Graduate College, requests for deductions are to be made to the Treasurer of the University. No deductions are made for temporary absence.

The prices charged for residence in the Graduate College include furnished rooms, light, heat, attendance, and board, but not personal laundry. The rooms are divided into six groups, with the following present total charges to graduate

students, assistants, and instructors, for furnished rooms, board, light, heat, and attendance for the academic year of thirty-six weeks:

Group I		$320.00
Group II		$340.00
Group III		$360.00
Group IV	Double	$380.00
	Single	$400.00
Group V	Double	$420.00
	Single	$430.00
Group VI		$500.00

The average weekly residential cost to the student thus ranges from $8.88 in Group I to $13.88 in Group VI. One person occupying a double suite alone is charged two-thirds of the price for two occupants. Arrangements for members of the Faculty, other than Instructors, who desire to reside in the Graduate College, are made at an advance over the graduate students' rates.

Graduate students rooming outside may be admitted to the table and other privileges of the Graduate College, except residence, at a charge of $240.00 for the academic year. Graduate students of the University who are not at the table nor resident in the buildings are invited to avail themselves of the other privileges of the Graduate College. Coupon books for occasional meals are furnished at a moderate cost for the use of the members of the Faculty, the graduate students, and their invited guests, as well as to the Trustees and alumni of the University.

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